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DEPARTMENT OF THE AIR FORCE

SUPPORTING DATA FOR FISCAL YEAR 1999 AMENDED BUDGET ESTIMATES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

DESCRIPTIVE SUMMARIES



FEBRUARY 1998

VOLUME I

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**DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF  
THE DEPARTMENT OF THE AIR FORCE RESEARCH AND DEVELOPMENT PROGRAM  
FY1999 AMENDED BUDGET ESTIMATES  
FEBRUARY 1998**

**INTRODUCTION AND EXPLANATION OF CONTENTS**

1. (U) GENERAL. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY1999 President's Budget Submission (PB), except those listed in paragraph 2 - 4 below. All formats in this document are in accordance with the revised guidelines of the DoD Financial Management Regulation, Volume 2B, Chapter 5, insofar as possible.
  - a. Contents: Exhibits R-2 and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY1999 RDT&E program except the classified program elements. The formats and contents of this documents are in accordance with the guidelines and requirement of the Congressional committees insofar as possible.
  - b. The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
  - c. Volume III contains the Facilities exhibit (DoD Form 1391) and Combating Terrorism exhibit.

2. (U) CLASSIFICATION.

- a. All R-2 and R-3 exhibits contained in Volumes I and II are UNCLASSIFIED. Classified R-2 and R-3 exhibits are not included in the submission due to the level of security classification and necessity of special security clearances.

3. (U) COMPARISON OF FISCAL YEARS 1998 AND 1999 DATA. A direct comparison of Fiscal Years 1998 and 1999 data shown in this document with corresponding data in the descriptive summaries dated February 1997 will reveal differences. The table highlights the relationship of the FY 1999 budget structure to the FY 1998 budget approved by Congress.

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PROGRAM ELEMENT COMPARISON SUMMARY

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Program Element	Remarks
BUDGET ACTIVITY 1: BASIC RESEARCH No changes	
BUDGET ACTIVITY 2: APPLIED RESEARCH DEVELOPMENT	
0602201F Phillips Laboratory Exploratory Dev	Project 4397 terminates in FY99
0602202F Armstrong Laboratory Exploratory Dev	Project 1900 terminates in FY99 Project 7755 terminates in FY99
0602203F Aerospace Propulsion	Project 3012 New Start in FY99
0602204F Aerospace Avionics	Project 2001 terminates in FY99
0602702F Command, Control & Communication	Project 2338 terminates in FY99
0602805F Dual Use Applications Program	Project 4770 New Start in FY99
0603852F CV-130J DEM/VAL	Project 4025 terminates in FY99
0603856F AF NRO Partnership	Project 4782 New Start in FY99
BUDGET ACTIVITY 3: ADVANCE TECHNOLOGY DEVELOPMENT	
0603106F Logistics Systems Technology	In FY99 and out, Projects 2745, 2940 and 2950 have been combined into Project 2745

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0603108F Integrated Data Systems	Transferred to PE 78611F, Project 4654
0603253F Advanced Avionics Integration	Software reuse efforts from Project 3833 transferred to Project 2735

BUDGET ACTIVITY 4: DEMONSTRATION AND VALIDATION  
0603441F Space Based IR Arch (Dem/Val)      Project 0008 completed in FY98  
(Space)

0603852F C-130J Dem/Val      Project 4025 terminates in FY98

0603853F EELV D/V (Space)      Completed in FY98

0603860F Joint Precision & Landing  
Systems Dem/Val      New Start in FY99

0603876F Space Base Laser  
Systems Dem/Val      New Start in FY99

BUDGET ACTIVITY 5: ENGINEERING AND MANUFACTURING DEVELOPMENT

0207414F Combat Intelligence System      PEs 0604321F, 0207431F and 0305158F have been consolidated into  
PE 0207414F, Project 2758

0604201F Integrated Avionics Planning and      Project 2258 completes in FY99

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0604218F Engine Model Derivation Program	Project 2634 terminates in FY99
0604227F Flight Simulator Dev	Project 4673 New Start in FY99 Projects 2325 and 2769 terminate in FY99
0604243F Manpower, Personnel and Training	Projects 3818 and 4369 terminate in FY99
0604441F Space Base IR Arch	Project 4598 transferred to PE 0604442F in FY99
0604442F Space Based Infrared Sys (SBIRS) Low	New Start in FY99, Funds transferred from PE 0604441F
0604602F Armament Ordnance Dev	MMHE moved from SEEK EAGLE (PE 0207590F/ Project 2784) to Armament Ordnance Development to align funding with ASC/CC decision to move MMHE out of the SEEK EAGLE program office.
0604611F Joint Standoff Land Attack Missile	Per Congressional direction funds are held for administrative reasons in PE 0207325F, Project 4515 pending completion of Alternative of Analysis
0604740F Computer Resource Technology	Project 2522 terminates in FY99
0604762F Common Low Observable Verification System	Project 4683 New Start in FY99
0604805F Duap Commercial Operations	New Start in FY99
0605011F RDT&E for Aging Aircraft	New Start in FY99

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0605704F Theater Air Defense BMC41

Transfer to JTAMDO, PE 0605126J

#### BUDGET ACTIVITY 6: RDT&E MANAGEMENT SUPPORT

0603402F Space Test Program

Transferred to PE 0605864F beginning in FY99

0605853F Environmental Conservation

Transferred to O & M, PE 0702896F for non-test-specific base operations support

0605854F Pollution Prevention

All funds for Test Facility base operations support transferred to O&M, PE 0702896F

0605856F Environmental Compliance

Transferred to O&M, PE 0702896F for non-test-specific base operations support

0605876F Minor Construction

Transferred to O&M, PE 0702896F for non-test-specific base operations support

0605878F Maintenance and Repair

Transferred to O&M, PE 0702896F for non-test-specific base operations support

0605896F Real Property Services

Transferred to O&M, PE 0702896F for non-test-specific base operations support

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BUDGET ACTIVITY 7: OPERATIONAL SYSTEM DEVELOPMENT

0102325F Joint Surveillance System	Projects 2976 and 4559 moved to PE 0102326F, Project 4592
0207131F A-10 Squadrons	Project 3861 New Start in FY99
0207217F Podded Reconnaissance System	Project 4611 completed in FY98
0207590F Seek Eagle	Project 2784 moved from Seek Eagle to Armament Ordnance Development (PE 0604602F/ Project 4696)
0207601F USAF Wargaming & Simulation	Project 1011 transferred to PE 0308610F Project 2888 transferred to PE 0207590F Project 4567 FY99 New Start
0207605F Wargaming & Simulation Center	New Program Element in FY99. FY98 funds in PE 27601F
0208030F WRM-Ammunition	Combined with 0207323F
0208019F Tactical Information Program	Project 4778 New Start in FY99
0208031F WRM-Equipment/Secondary Items	Project 4668 New Start in FY99
0302015F E-4B National Airborne Operations	Project 4777 New Start in FY99
0303131F Minimum Essential Emergency Communications Network	Project 4610 New Start in FY99

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0303140F Information Systems Security Program	Project 4579 New Start in FY99
0303144F Electromagnetic Compatibility	Project 649E was transferred to DISA, PE 0303153K.
0303150F WWMCCS/Global Command	FY99 and out year funding transferred from 0303152F. PE title changed from Automated Data Processing Equipment
0303152F Automated Data Processing Equipment	Transferred to PE 0303150F
0305099F Global Air Traffic Management (GATM)	Projects 4689 and 4690 New Start in FY99
0305158F Tactical Terminals	Project 4394 moved to PE 0207414F, Project 2758
0305176F Combat Survivor Evader Locator	FY98 and prior years were funded in PE 0603853F and PE 0603854F
0305910F Spacetrack	Project 4241 completed in FY98
0305953F Evolved Expendable Launch Veh (Space)	New Start in FY99
0308601F Modeling & Simulation Support	New Start in FY99
0401119F C5 Airlift Squadrons	Project 4495 name change to Avionics Modernization Program
0401218F KC-135S	Project 4286 New Start in FY99

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0708071F Joint Log Program-Ammunition	New Start in FY99. FY97 and FY98 funds reclassified from O&M to RDT&E
0708611F Support Systems Development	Project 4654 New Start in FY99. Funds transferred from 0603018F
0803734F Crypto/Sigint Related Skill	Project 1005 completes in FY99
1001018F NATO JSTARS	Project 0002 terminates in FY99

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MILSTAR Satellite Comm Sys (Space)	0303601F	1537
Minpwr Pers & Trng Development	0604243F	837
Modeling and Simulation Support	0308601F	1729
Munitions Dispenser Development	0604600F	919
National Airspace System	0305137F	1599
National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)	0603434F	539
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Space and Missile Rocket Propulsion	0603302F	359
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ALPHABETICAL LISTING

Program Element Title

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PE NUMBER: 0601102F

UNCLASSIFIED

PE TITLE: Defense Research Sciences

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PE NUMBER AND TITLE	
1 - Basic Research										0601102F Defense Research Sciences	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		182,082	196,251	209,395	228,104	230,992	234,718	239,378	Continuing	Continuing	
2301 Physics		18,479	20,525	20,756	21,702	21,973	22,320	22,756	Continuing	Continuing	
2302 Solid Mechanics and Structures		12,087	13,588	15,380	16,077	16,273	16,530	16,853	Continuing	Continuing	
2303 Chemistry		25,573	27,069	25,908	27,164	27,574	28,087	28,707	Continuing	Continuing	
2304 Mathematical and Computer Sciences		28,919	27,401	34,525	45,239	45,807	46,540	47,449	Continuing	Continuing	
2305 Electronics		21,129	24,788	23,473	24,543	24,850	25,244	25,738	Continuing	Continuing	
2306 Structural Materials		11,730	14,017	12,160	12,708	12,861	13,063	13,318	Continuing	Continuing	
2307 Fluid Mechanics		8,453	11,573	7,212	7,529	7,618	7,736	7,886	Continuing	Continuing	
2308 Propulsion		10,075	9,830	18,675	19,524	19,765	20,078	20,470	Continuing	Continuing	
2310 Atmospheric Sciences		7,239	6,244	5,562	5,802	5,868	5,958	6,075	Continuing	Continuing	
2311 Space Sciences		4,628	4,320	6,827	7,127	7,211	7,321	7,464	Continuing	Continuing	
2312 Biological Sciences		12,241	13,917	13,065	13,654	13,821	14,036	14,312	Continuing	Continuing	
2313 Human Performance		8,729	7,877	12,567	13,133	13,292	13,500	13,764	Continuing	Continuing	
4113 Science and Engineering Education Programs		12,800	15,102	13,285	13,902	14,079	14,305	14,586	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 1 - Basic Research

## 0601102F Defense Research Sciences

(U) **A. Mission Description and Budget Item Justification:** This Basic Research program, managed by the Air Force Office of Scientific Research (AFOSR), supports Air Force research efforts comprised of in-house investigations in Air Force laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research in technologies critical to the Air Force mission. These technologies include aerospace structures, aerodynamics, materials, propulsion, power, electronics, computer science, directed energy, conventional weapons, life sciences, and atmospheric and space sciences. All projects are coordinated through the Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds. All technology areas are subject to long-range research planning and technical review by tri-Service scientific planning groups that interface and support the Defense Technology Area Planning process.

(U) **B. Program Change Summary (\$ in Thousands):**

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	210,763	226,832	230,210	Cost
(U) Appropriated Value	219,475	207,249		Cont
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-4,597	-6,856		
b. SBIR	-4,115	-4,142		
c. Omnibus/Other Above Threshold Reprogrammings	-27,552			
d. Below Threshold Reprogrammings	-901			
e. Rescissions	-228			
(U) Adjustments to Budget Year Since FY 1998 PB			-20,815	
(U) Current Budget Submit/FY 1999 PB	182,082	196,251	209,395	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) **C. Other Program Funding Summary:** Not Applicable.(U) **D. Schedule Profile:** Not Applicable.

UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2301

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2301 Physics		18,479	20,525	20,756	21,702	21,973	22,320	22,756	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project provides the fundamental knowledge required to conceptualize and develop new Air Force weapons and also establishes the basis for many technologies critical to the Air Force. Research in physics has an impact on electromagnetic countermeasures, nuclear weapons effects, communications, and non-destructive and non-intrusive testing and analysis, as well as new materials development. Other technologies affected include avionics, laser technology, and propulsion research. The primary areas of research supported by this project are Photonic Physics, Optics, Plasma Physics, and Atomic and Molecular Physics.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$8,518 Performed laser and optical physics research for aerospace applications.
- (U) Demonstrated infrared laser devices for application to spoofing infrared missile seekers.
- (U) Devised and demonstrated efficient laser wavelength converters based on newly developed nonlinear optical materials. Higher efficiency enables more compact target designators and illuminators.
- (U) Examined innovative, laser-assisted processing techniques to reduce the processing time and cost of micro-electromechanical systems (MEMS) for control, sensing, and health monitoring applications in mini-satellites.
- (U) \$4,352 Conducted plasma physics research for future directed-energy weapons, affordable low-observables, and space communications and surveillance.
- (U) Identified the critical importance of high-vacuum conditions to reliable long-pulse operation of ultrahigh power microwave sources for enemy air defense suppression.
- (U) Established validity of highly collisional ionized gas to serve as a low-cost, switchable, broadband microwave (radar) absorber.
- (U) \$5,609 Studied atomic, molecular, and imaging physics to enhance space surveillance capabilities.
- (U) Extended existing imaging techniques to the physical limits for monitoring space debris and space assets for deep-space surveillance.
- (U) Devised theory for power requirement versus pulse format for artificial, guide-star adaptive telescope development.
- (U) \$18,479 Total

Project 2301

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Exhibit R-2 (PE 0601102F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>	<b>February 1998</b>	<b>2301</b>
(U) FY 1998 (\$ in Thousands):			
- (U)	\$7,456	Perform laser and optical physics research for aerospace applications.	
- (U)		- (U) Intensify research in lasers and optical devices for spoofing and damaging infrared seeking missiles.	
- (U)		- (U) Examine physics of lethal and nonlethal directed-energy for speed-of-light target kill.	
- (U)	\$4,840	- (U) Direct studies toward developing optimum lasers for high-image quality telescopes for space surveillance.	
		Conduct plasma physics research for future directed-energy weapons, affordable low-observables, and space communications and surveillance.	
- (U)		- (U) Study the power limits and frequency ranges achievable by multi-beam microwave sources; transition results for Airborne Warning and Control System (AWACS) upgrades.	
- (U)		- (U) Reduce the total electrical power required to maintain high-pressure ionized gas volumes necessary for air and space low-observable applications.	
- (U)	\$5,229	Study atomic, molecular, and imaging physics to enhance space surveillance capabilities.	
- (U)		- (U) Enhance concepts for precision time and frequency standards, enabling high data rate communication and advanced navigation.	
- (U)	\$3,000	- (U) Improve spatial and spectral imaging for space surveillance and targeting precision.	
- (U)	\$20,525	Perform basic research in adaptive optics for application in advanced ground-based telescopes.	
		Total	
(U) FY 1999 (\$ in Thousands):			
- (U)	\$9,578	Perform laser and optical physics research for aerospace applications.	
- (U)		- (U) Expand knowledge of lasers and optical devices for infrared countermeasures applications.	
- (U)	\$4,886	- (U) Identify advanced applications of laser physics and devices for directed-energy weapons.	
		Conduct plasma physics research for future directed-energy weapons, affordable low-observables, and space communications and surveillance.	
- (U)		- (U) Advance state-of-the art in explosive-driven power generators, enabling future self-contained airborne directed-energy weaponry.	
- (U)		- (U) Examine the scientific feasibility of using collisional ionized gas volumes to protect friendly assets from directed-energy weapon threats.	
- (U)	\$6,292	Study atomic, molecular, and imaging physics to enhance space surveillance capabilities.	
- (U)		- (U) Develop advanced atomic and molecular processes to produce ideal performance time standards.	
- (U)	\$20,756	- (U) Investigate unconventional imaging approaches for surveillance and target detection and recognition.	
		Total	

Project 2301

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>		<b>2301</b>
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Previous President's Budget (FY 1998 PB)	18,503	20,362	20,680
(U) Current Budget Submit/FY 1999 PB	18,479	20,525	20,756
			Total
			Cost
			Cont
			Cont
<b>(U) Change Summary Explanation:</b>			
Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
- (U) PE 0602203F, Aerospace Propulsion.			
- (U) PE 0602601F, Phillips Laboratory.			
<b>(U) D. Schedule Profile: Not Applicable.</b>			

Project 2301

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
1 - Basic Research		0601102F Defense Research Sciences								2302	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2302	Solid Mechanics and Structures	12,087	13,588	15,380	16,077	16,273	16,530	16,853	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This project seeks to develop a fundamental understanding of the behavior of aerospace materials, structures, and supporting facilities, leading to cost-effective development and safe and reliable operation of superior weapons and defensive systems. Research includes such diverse topics as the micromechanical design of advanced materials, modeling and simulation of the dynamic behavior of aircraft, missiles, and large space structures, and technology integration for the performance and survivability enhancement of these systems. This research will result in expanding the fundamental knowledge base to better understand the mechanics of deformation and damage of aerospace materials and structures. Also, this research will lead to an improved understanding of the aeroelastic and acoustic behavior of airframe and engine structures, and the dynamic behavior of launch vehicles and space structures.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$4,442 Studied thermomechanical behavior of advanced structural materials to enhance the longevity and performance of aerospace vehicles and structures.</li> <li>- (U) Performed research into micromechanics of high-temperature composite materials for use in wing and fuselage structures.</li> <li>- (U) Developed models for three-dimensionally reinforced composite materials. Models provide for performance testing and predictive modeling, eliminating steps involved in the manufacture of full-scale prototypes.</li> <li>- (U) \$4,080 Modeled development of materials needed for aerospace structures.</li> <li>- (U) Researched scaling issues in structural mechanics and developed necessary computational techniques for handling homogenization in modeling and simulations. Homogenization techniques are computationally very fast and efficient.</li> <li>- (U) Investigated the fundamental behavior of vibro/acoustic systems and aeroelastic structures to apply toward reduction of noise and structural fatigue in aircraft with internal bomb bays (B-1, F-22, Joint Strike Fighter).</li> <li>- (U) \$3,565 Gained fundamental particulate mechanics knowledge to improve weapons performance.</li> <li>- (U) Developed a first principles understanding of the behavior of geomaterial fracture mechanics and damage accumulation. First used in "Live Fire" computer codes to support "smart bomb" testing.</li> <li>- (U) Investigated strain rate versus confining pressures of geomaterials impacted by penetrating weapons, for optimization of weapon design and targeting variables. Small "smart bomb" test validated concepts.</li> <li>- (U) \$12,087 Total</li> </ul>											

Project 2302

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Exhibit R-2 (PE 0601102F)

## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 1 - Basic Research

0601102F Defense Research Sciences

2302

## (U) FY 1998 (\$ in Thousands):

- (U) \$4,994 Study thermomechanical behavior of advanced structural materials to enhance the longevity and performance of aerospace vehicles and structures.
- (U) Research the micromechanics of high-temperature composite materials for aerospace structural systems and coatings.
- (U) Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.
- (U) \$4,586 Model development of materials needed for aerospace structures.
- (U) Examine issues related to dynamics and mechanics of materials at very small scales, as necessary for the development of micro-electromechanical systems.
- (U) Research the fundamental behavior of actuator/structure interaction for control of shell structures in vibro/acoustic environments.
- (U) Develop a fundamental understanding of the behavior of aeroelastic structures to apply toward reduction of noise and structural fatigue in aircraft.
- (U) \$4,008 Seek fundamental particulate mechanics knowledge to improve weapons performance.
- (U) Obtain quantitative relationships to describe the fundamental mechanics governing the behavior of geomaterial systems.
- (U) Investigate the fundamental relationship of geomaterials undergoing high strain rate loadings with increasing confining pressures, as occurs when impacted by penetrating weapons.
- (U) \$13,588 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$5,652 Study thermomechanical behavior of advanced structural materials to enhance the longevity and performance of aerospace vehicles and structures.
- (U) Perform research in the micromechanics of high-temperature composite materials for aerospace structural systems and coatings.
- (U) Investigate the fracture behavior and thermomechanical behavior of high temperature alloys and composite materials for engine and hypersonic vehicle applications.
- (U) \$5,191 Model development of materials needed for aerospace structures.
- (U) Predict the dynamic and material behavior of structures for micro-electromechanical systems.
- (U) Determine the response of shell structures in vibro/acoustic environments.
- (U) Control the response of aeroelastic structures to apply toward reduction of noise and structural fatigue in aircraft.
- (U) \$4,537 Seek fundamental particulate mechanics knowledge to improve weapons performance.
- (U) Investigate quantitative relationships that describe the fundamental mechanics governing the behavior of geomaterial systems.
- (U) Predict the trajectory and penetration depth of earth penetrator weapons using advanced computational models.
- (U) \$15,380 Total

Project 2302

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Exhibit R-2 (PE 0601102F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>	<b>2302</b>	
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
(U) Previous President's Budget (FY 1998 PB)		FY 1997	
(U) Current Budget Submit/FY 1999 PB		14,384	
		12,087	
		FY 1998	FY 1999
		15,608	15,838
		13,588	15,380
		Total	
		Cost	
		Cont	
		Cont	
<b>(U) Change Summary Explanation:</b>			
Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
- (U) PE 0602102F, Materials.			
- (U) PE 0602201F, Aerospace Flight Dynamics.			
- (U) PE 0602202F, Human Systems Technology.			
- (U) PE 0603211F, Aerospace Structures.			
- (U) PE 0602203F, Aerospace Propulsion.			
<b>(U) D. Schedule Profile: Not Applicable.</b>			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 1 - Basic Research

PE NUMBER AND TITLE

## 0601102F Defense Research Sciences

PROJECT

2303

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2303 Chemistry		25,573	27,069	25,908	27,164	27,574	28,087	28,707	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** In the chemistry research program, knowledge and understanding is sought in chemical synthesis and reactivity, polymer chemistry, surface science, and molecular dynamics. The focus is on building the knowledge base required to develop new materials and to improve the synthesis of existing materials. Specific research focus areas include functional and structural materials, electronic and photonic materials, biomimetic materials, electromagnetic and conventional weaponry, propellants, and environmentally safer materials. This program conducts novel synthesis and characterization of higher performance and lower cost nonmetallic and biomimetic materials for application as infrared sensors, and safer, more efficient fire suppressants and deicer/anti-ice materials, and mechanistic studies of biological corrosion and semiconductor nanolithography. The chemistry program also investigates effects of chemical and morphological structures on functional and mechanical properties of polymeric materials. The program also explores atomic and molecular surface interactions that can limit performance of electronic devices, compact power sources, and lubricant materials, and investigates molecular energy release mechanisms and energy storage in metastable molecular systems to foster advances in laser weapons development and new chemical propellants.

## (U) FY 1997 (\$ in Thousands):

- (U)	\$7,672	Studied chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance.
- (U)		Developed photorefractive polymers for aerospace applications such as protection from laser threats, optical target recognition and tracking, and laser power amplification.
- (U)		Investigated effects of solvation and condensed media on chemical synthesis of energetic materials used for advanced propulsion systems.
- (U)	\$7,161	Investigated chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems.
- (U)		Investigated mechanisms of chemical corrosion of aluminum for aging aircraft preservation.
- (U)		Formulated molecular-level model for simulating the behavior of hydrocarbon-based lubricants in aircraft and spacecraft operating in extreme temperature and pressure environments.
- (U)	\$10,740	Performed research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications.
- (U)		Developed high-energy, photo-pumped, gas-phase mid-infrared laser systems for aircraft protection.
- (U)		Identified source of pure-rotational infrared emission from atmospheric radicals, enabling determination of atmospheric optical backgrounds for surveillance systems.
- (U)		Determined key chemical reactions to accelerate ignition in hypersonic vehicle engines.
- (U)	\$25,573	Total

Project 2303

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Exhibit R-2 (PE 0601102F)

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## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>	<b>February 1998</b>	<b>2303</b>
<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <p>- (U) \$8,121 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance.</p> <p>- (U) Design ideal polymer blends for structural and functional applications such as impact-resistant composites, high-temperature toughened canopies, and power-efficient flat panel displays.</p> <p>- (U) Investigate molecules possessing efficient two-photon processes, enabling laser hardening, optical data storage, and advanced imaging techniques.</p> <p>- (U) Design and synthesize novel inorganic polymer systems for enhanced rocket motor insulation.</p> <p>- (U) Investigate chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems.</p> <p>- (U) Develop novel methods for non-intrusive detection of hidden corrosion in aluminum elements of aging aircraft.</p> <p>- (U) Investigate surface growth and characterization processes of thin films coatings for prevention of aircraft corrosion.</p> <p>- (U) Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications.</p> <p>- (U) Create lightweight, chemical laser systems for missile defense applications.</p> <p>- (U) Investigate effects of ion reactions with hydrocarbon fuels on combustion initiation in hypersonic vehicle engines.</p> <p>- (U) Develop novel technique to probe bonding in ceramic materials. Technique will enable development of improved thermal-barrier coatings in aircraft engines.</p> <p>- (U) \$27,069 Total</p> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <p>- (U) \$7,772 Study chemical synthesis of compounds with tailored functional and structural properties for improved aerospace vehicle performance.</p> <p>- (U) Investigate the long-term durability of polymers that operate in extreme environments such as in air-breathing propulsion systems, and aerospace vehicles operating in low earth orbit or deep space.</p> <p>- (U) Develop organic coatings for aircraft protection applications that can withstand chemical and photochemical deterioration.</p> <p>- (U) Create functional polymers for optical signal processing and advanced control of phased-array radar and laser radar.</p> <p>- (U) Investigate chemical process at surfaces and interfaces to improve performance and maintainability of Air Force systems.</p> <p>- (U) Formulate an atomistic model for corrosion prevention in aluminum aircraft components.</p> <p>- (U) Develop new vapor phase lubricants for operation in extreme temperature environments.</p> <p>- (U) Perform research on molecular-level energy transfer, energy extraction, and chemical reactivity research for advanced aerospace applications.</p> <p>- (U) Investigate high-energy, metastable molecular states for use in advanced rocket propulsion systems.</p> <p>- (U) Develop and apply methods for simulating molecular energy transfer in extreme aerospace environments to predict and interpret aircraft and spacecraft signatures.</p> <p>- (U) Investigate formation and stability of molecular clusters for use as nanoscale sensors in aircraft and uninhabited air vehicles.</p> <p>- (U) \$25,908 Total</p>			
Project 2303		Exhibit R-2 (PE 0601102F)	

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 1 - Basic Research

PE NUMBER AND TITLE

0601102F Defense Research Sciences

PROJECT

2303

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	Total
	30,560	31,096	31,764	Cost
	25,573	27,069	25,908	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.

(U) D. Schedule Profile: Not Applicable.

Project 2303

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Exhibit R-2 (PE 0601102F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
1 - Basic Research		0601102F Defense Research Sciences								2304	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2304	Mathematical and Computer Sciences	28,919	27,401	34,525	45,239	45,807	46,540	47,449	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This research focuses on mathematical modeling, simulation, and control of complex systems and provides analytical and computational methods. Topics include: effective utilization of high-performance computers; control of aerospace systems; models and computational tools for the design of aircraft, missiles, or other weapons; efficient production of large-scale, well documented computer programs and software; communication and information theory; signal processing; artificial intelligence in surveillance systems or independent weapons; reliability and maintainability; and the allocation of resources in logistics or operational activities using ideas from optimization and linear programming theories.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$9,833 Studied physical mathematics, control, and signal processing supporting the Air Force's New World Vista (NWV) programs.</li> <li>- (U) Developed a new, nonlinear controller design technology based on bifurcation theory. Technology is transitioning for advanced research and industrial applications for improved performance (including reduced stall limits) and reduced jet engine weights.</li> <li>- (U) Derived mathematical description and simulation capability of a new solid state laser design, known as a master oscillator power amplifier. Simulation capabilities promise to double the design's predicted laser output.</li> <li>- (U) \$10,410 Performed research on computer software and systems for battlespace information management.</li> <li>- (U) Developed formal methods for discovering errors in the specifications for distributed system software in embedded avionics systems. The research advances the capability to produce error-free software.</li> <li>- (U) Created automated tools for browsing open source information, including the World Wide Web, for intelligence analysis.</li> <li>- (U) Investigated computational science for improved design and simulation of advanced aerospace systems.</li> <li>- (U) Derived new adaptive algorithms for the accurate numerical prediction of radar scattering from realistic air vehicles. Built an automatic interface to existing computer assisted design (CAD) files, which drastically speeds the computational process.</li> <li>- (U) Developed a new, fast algorithm to calculate design sensitivities in complex systems of nonlinear partial differential equations. This will enable effective use of optimal design strategies in a wide range of aerospace systems.</li> <li>- (U) \$28,919 Total</li> </ul>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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PROJECT

## 1 - Basic Research

0601102F Defense Research Sciences

2304

## (U) FY 1998 (\$ in Thousands):

- (U) \$9,316 Study physical mathematics, control, and signal processing supporting the Air Force's New World Vista (NWV) programs.
- (U) Explore new concepts of differential flatness for fast, on-line trajectory generation for aggressive flight in unmanned combat air vehicles.
- (U) Develop appropriate multi-resolution methods, including time-frequency analysis and the generalizations of Fourier and wavelets transforms, for use in military signal transmission and reduced signature automatic target recognition scenarios.
- (U) \$9,865 Perform research on computer software and systems for battlespace information management.
- (U) Develop scientific foundations to permit integration of information from radically different sources for global battlefield awareness.
- (U) Investigate methods to support the utilization of secure, transportable software agent technology in command and control networks.
- (U) \$8,220 Investigate computational science for improved design and simulation of advanced aerospace systems.
- (U) Derive higher order numerical methods for the time-accurate computation of non-smooth, unsteady flows, minimizing reliance upon steady flow approximations. This will lead to optimal design capabilities for jet engine combustors and other aircraft systems.
- (U) Develop a mathematical infrastructure for robust virtual engineering to radically improve Air Force modeling and simulation capabilities in the presence of multiple uncertainties such as random disturbances or numerical errors.
- (U) \$27,401 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$11,738 Study physical mathematics, control, and signal processing supporting the Air Force's NWV programs.
- (U) Develop modeling, identification, control, and signal processing capabilities necessary for the integrated control of jet engine, aerodynamic, and combustor instabilities. This will lead to lighter weight engines with greatly improved performance characteristics.
- (U) Expand efforts in mathematical modeling of advanced materials, including composites and smart skins containing shape memory alloys.
- (U) \$12,429 Perform research on computer software and systems for battlespace information management.
- (U) Expand research in transportable agent technology to support defensive information warfare applications.
- (U) Expand research in real-time problem solving strategies to support dynamic planning and execution.
- (U) \$10,358 Investigate computational science for improved design and simulation of advanced aerospace systems.
- (U) Integrate new multidisciplinary optimization design strategies with higher order, time accurate flow solvers for improved design of jet engines and other aerospace components.
- (U) Develop algorithms incorporating active control procedures involving magnetohydrodynamics, shock shape modification, and shock shape manipulation.
- (U) \$34,525 Total

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
<b>1 - Basic Research</b>		<b>2304</b>	
PE NUMBER AND TITLE		0601102F Defense Research Sciences	

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	30,828	34,254	34,859	Cost
	28,919	27,401	34,525	Cont

(U) Change Summary Explanation:  
 Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603728F, Advanced Computer Technology.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2305

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2305 Electronics		21,129	24,788	23,473	24,543	24,850	25,244	25,738	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Research in this project emphasizes electronic devices and systems that enable new Air Force capabilities such as battle information management systems, countermeasures, sensors, and the more electric aircraft concept. The goals are to increase the data and information processing speed of electronic systems, to firmly control their complexity and reliability, and to improve the security and reliability of information and data transmission. Research is conducted in electronic processes which will enable the engineer to model and predict performance of electronic materials, devices, and systems for high-speed digital and analog signal processing, microwave and millimeter wave signal and power generation, superconducting, optical signal processing, and radiation effects.

## (U) FY 1997 (\$ in Thousands):

- (U) \$11,388 Studied semiconductor electronic materials, advanced devices, and applications.
- (U) Investigated new device and circuit concepts based on three-dimensional integration; enables functionally superior and lower-cost electronic systems.
- (U) Examined radiation hardening of electronic and optoelectronic devices and systems. Hardening increases survivability and mission lifetimes of space-borne systems.
- (U) \$6,085 Sought fundamental understanding of optoelectronic information processing and storage.
- (U) Identified opportunities to tailor electronic and photonic properties in artificial, three-dimensionally ordered structures, leading to compact, functionally flexible sensors.
- (U) \$3,656 Investigated superconducting and nanoscopic materials, devices and applications.
- (U) Developed manufacturable process for fabricating high-temperature superconducting (HTS) Josephson junctions. Useful for applications such as frequency-agile phased arrays.
- (U) Devised technique for observing active corrosion in aluminum aerospace structures. Provides a non-destructive, cost-effective, evaluation process.
- (U) \$21,129 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>	<b>February 1998</b>	<b>2305</b>
<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$13,360 Study semiconductor electronic materials, advanced devices, and applications.</li> <li>- (U) Investigate non-stoichiometric compound semiconductor materials and devices, leading to low-power, radiation-tolerant systems.</li> <li>- (U) Enhance materials processing of nitride compounds for new solar-blind sensors.</li> <li>- (U) \$7,137 Seek fundamental understanding of optoelectronic information processing and storage.</li> <li>- (U) Examine spectral hole burning memories, promising orders-of-magnitude enhancement in information storage.</li> <li>- (U) Investigate micro-lasers needed to solve electronic interconnection problems, as device density and complexity increase.</li> <li>- (U) \$4,291 Investigate superconducting and nanoscopic materials, devices and applications.</li> <li>- (U) Identify lower limit of surface resistance.</li> <li>- (U) Investigate Josephson junction arrays as possible terahertz radiation sources for surveillance applications.</li> <li>- (U) Fabricate new nanometer-scale magnetic structures for use in compact, energy-efficient electronics.</li> <li>- (U) Apply superconducting magnetic sensors to non-destructive evaluation of aerospace structures.</li> <li>- (U) \$24,788 Total</li> </ul> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$12,659 Study semiconductor electronic materials, advanced devices, and applications.</li> <li>- (U) Enhance research on interface control and stability in semiconductor quantum structures for improved laser and detector applications, including low-photon count photo receivers.</li> <li>- (U) Investigate novel methods to electronically tailor compound semiconductors, to obtain complementary electron-device structures for ultra-high frequency logic circuits.</li> <li>- (U) Examine high-temperature electronics for use in hostile environments.</li> <li>- (U) \$6,757 Seek fundamental understanding of optoelectronic information processing and storage.</li> <li>- (U) Investigate advanced communications, signal processing, and computing.</li> <li>- (U) \$4,057 Examine novel micro-lasers and ultra-high density information storage and retrieval.</li> <li>- (U) Investigate superconducting and nanoscopic materials, devices and applications.</li> <li>- (U) Investigate superconducting microwave properties and devices for advanced communications.</li> <li>- (U) Develop quantum nanoelectronic and magnetic structures for higher speed signal processing and denser memory.</li> <li>- (U) Create higher current, high temperature, superconducting materials for power generation and storage on space platforms.</li> <li>- (U) \$23,473 Total</li> </ul>			

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PROJECT

2305

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	27,866	30,301	30,553	Cost
	21,129	24,788	23,473	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603728F, Advanced Computer Technology.

(U) D. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2306

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2306 Structural Materials		11,730	14,017	12,160	12,708	12,861	13,063	13,318	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Research focuses on metallic, polymeric, and ceramic and nonmetallic structural materials. Materials research provides the knowledge for improving the performance, cost, and reliability of structural materials. Structural materials research studies a broad range of material properties such as strength, toughness, fatigue resistance, and corrosion resistance of airframe, turbine engine, and spacecraft materials. Emphasis is on refractory alloys, intermetallics, polymer composites, metal and ceramic matrix composites, and advanced ceramics, such as alumina, silicon carbide, silicon nitride, and carbon/carbon. Research in new processing methods complements research on materials properties. Direct goals of this program are to increase the operating temperature of engine materials which will further increase thrust-to-weight ratio of engines, develop improved aerospace vehicle structural materials, and control or eliminate advance material reliability issues related to high temperature strength, toughness, fatigue, and environmental conditions.

## (U) FY 1997 (\$ in Thousands):

- (U) \$6,217 Sought fundamental understanding of very-high temperature, non-metallic materials for air-breathing engine applications to support Integrated High Performance Turbine Engine Technology (IHPTET) and Integrated High Payoff Rocket Propulsion Technology (IHPRPT).
- (U) Studied fundamentals of one of the best candidate materials for turbine engine applications; developed the best high-temperature creep resistant material to date -- yttrium-alumina garnet.
- (U) Demonstrated a novel design and fabricated a self-reinforced silicon-nitride ceramic material. This material shows potential as one of the best structural materials known for high-temperature applications.
- (U) Performed research on metallic systems for engines and airframe applications.
- (U) Examined microstructural mechanisms responsible for anomalous engine, high-cycle fatigue behavior of Ti-based alloys. Examined interfacial stability of intermetallics and found novel approaches to improve ductility and fabricating engine parts for fighter aircraft.
- (U) Discovered a novel structural material -- metallic glass -- which is lighter, stronger, and tougher than aluminum. Shows potential for airframe applications.
- (U) Studied longevity of polymeric composites for advanced airframe applications.
- (U) Studied degradation of polymeric materials due to extreme processing environments and operating conditions.
- (U) Clarified relationship of chemical changes to long-term durability of composites.
- (U) \$11,730 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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PE NUMBER AND TITLE

PROJECT

1 - Basic Research

0601102F Defense Research Sciences

2306

(U) FY 1998 (\$ in Thousands):

- (U)	\$7,569	Seek fundamental understanding of very-high temperature, non-metallic materials for air-breathing engine applications to support Integrated High Performance Turbine Engine Technology (IHPTET) and Integrated High Payoff Rocket Propulsion Technology (IHPRPT).
- (U)		Investigate oxide-oxide eutectics, novel ceramic materials with excellent high-temperature mechanical stability for turbine blades and combustor lining applications.
- (U)	\$5,046	Investigate the new phenomenon of polycrystal-to single crystal conversion. Establish applicability of this novel phenomenon to turbine blade manufacturing.
- (U)		Perform research on metallic systems for engines and airframe applications.
- (U)		Elucidate the atomic and microstructural mechanisms responsible for primary creep in titanium (Ti)-based alloys. The primary creep of Ti-alloys has been implicated as one of the major factors controlling the durability of turbine and compressor blades in Air Force engines.
- (U)	\$1,402	Develop material solution to quantify and provide solution to high-cycle fatigue problem of Ti components in engines.
- (U)		Study molybdenum-based alloys as possible candidates for turbine blade applications.
- (U)	\$1,402	Study reliability and aging of polymeric composites.
- (U)		Conduct research on stress-induced change in solvent and moisture absorption behavior of polymer matrix composites.
- (U)		Investigate the elements of chemical and molecular structures on degradation of polymer-matrix composites.
- (U)	\$14,017	Total

(U) FY 1999 (\$ in Thousands):

- (U)	\$6,444	Perform fundamental studies of very-high temperature, non-metallic materials for air-breathing engine and space vehicle applications.
- (U)		Investigate coupled thermal and mechanical stability of very-high temperature oxide composites and eutectics for engine blade applications.
- (U)	\$4,378	Investigate ultra-high temperature materials systems, based on carbides, for rocket propulsion applications.
- (U)		Perform research on metallic systems for engines and airframe applications.
- (U)		Study thermal and mechanical stability of refractory metal systems for very-high temperature applications.
- (U)		Investigate functionally gradient structures for thermal barrier coatings and turbine blade applications to reduce weight and to increase engine operating temperature.
- (U)	\$1,338	Study polymeric composites life and reliability.
- (U)		Investigate free-volume effect in controlling moisture absorption mechanisms and rates in polymer matrix composites.
- (U)		Research non-destructive evaluation techniques on adhesive-bonded structures to detect precursor conditions prior to damage initiation.
- (U)	\$12,160	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
1 - Basic Research		2306	
PE NUMBER AND TITLE		0601102F Defense Research Sciences	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 1998 PB)	15,081	16,100	16,338
(U) Current Budget Submit/FY 1999 PB	11,730	14,017	12,160
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
-	(U) PE 0602102F, Materials.		
-	(U) PE 0603211F, Aerospace Structures.		
-	(U) PE 0708011F, Manufacturing Technology.		
-	(U) PE 0602203F, Aerospace Propulsion.		
-	(U) PE 0602201F, Aerospace Flight Dynamics.		
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2307

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
2307	Fluid Mechanics	8,453	11,573	7,212	7,529	7,618	7,736	7,886	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Research involves turbulence prediction and control, unsteady and separated flows, hypersonics, and internal fluid dynamics. This research provides fundamental knowledge, tools, data, concepts, and methods for improving the efficiency, effectiveness, and reliability of aerospace vehicles. Research provides an understanding of key fluid flow phenomena, improves theoretical models for aerodynamic prediction and design, and originates flow control concepts and predictive methods to expand current flight performance boundaries. Research includes the development of computational methods for complex flows, prediction of real gas effects in high-speed flight, control and prediction of turbulence in flight vehicles, propulsion systems, aero-optic applications, the dynamics of unsteady and separated flows, thrust vectoring and high lift concepts associated with enhanced performance and maneuverability, heat transfer and compressor instabilities in gas turbine engines, flow-structure interactions in both external and internal flows, and transport phenomena in structural materials processing.

## (U) FY 1997 (\$ in Thousands):

- (U) \$1,944 Conducted external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems.
- (U) Developed Large Eddy Simulation (LES) methodology to predict three-dimensional flow fields. New methodology will decrease the design cycle time for new aerospace vehicle configurations.
- (U) Derived hypersonic flow computational modeling techniques. These improved techniques will result in lower weight, less complex hypersonic vehicle configurations, at reduced cost.
- (U) \$4,036 Performed turbulence and flow control research to enhance air vehicle stability, performance, and control.
- (U) Investigated micro-flow control to reduce air vehicle drag and increase air vehicle lift. Research will increase air vehicle range and maneuverability.
- (U) Developed structure-based turbulence model for accurate flow field predictions: model will dramatically reduce the design cycle time and improve the accuracy of new computational design methodologies.
- (U) \$2,473 Conducted internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems.
- (U) Investigated the active stabilization of engine surge: research will provide methods to prevent destructive engine failures in flight.
- (U) Examined the effect of shocks/turbulence on film cooling turbine blades: research will result in longer turbine blade life, significantly reducing turbine blade life cycle costs.
- (U) \$8,453 Total

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2307

## (U) FY 1998 (\$ in Thousands):

- (U) \$2,662 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems.
- (U) Investigate fluid/structure interaction flow fields for optimized vehicle designs to reduce large vehicle weight. This research will also enhance the reliability and maintainability (R&M) of currently operating air vehicle systems.
- (U) Develop experiments for hypersonic model and theory development. These experiments validate the modeling efforts underway and allow design of lighter weight, less complex hypersonic vehicles.
- (U) \$5,525 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control.
- (U) Develop active flow-control strategies for flow reattachment in separated flow regions. These strategies will increase lift and reduce drag to increase vehicle range performance.
- (U) Explore low-dimensional computational models for turbulent boundary layer control. These models will be used in an active flow control scheme to reduce air vehicle drag, thus increasing range for greater mobility.
- (U) \$3,386 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems.
- (U) Explore use of micro-electrical mechanical system (MEMS) devices for turbine engine control. These devices would be used to reduce or eliminate High Cycle Fatigue (HCF) problems in current airbreathing propulsion systems.
- (U) Validate use of Large Eddy Simulation (LES) methodologies for turbomachinery flows. This research will decrease the design cycle time for new airbreathing propulsion systems.
- (U) \$11,573 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$1,630 Conduct external aerodynamics and hypersonics basic research for improved flight performance and control of Air Force air vehicle systems.
- (U) Develop fluid/structural interaction models based on flow field interaction research. Use of models in the design phase of new air vehicles will eliminate fatigue caused by unsteady structural loading. This research will reduce life cycle costs of new air vehicle systems.
- (U) Investigate novel concepts for hypersonic flow control. This research will reduce the size and weight/cost of new hypersonic air vehicles, thus allowing for increased global mobility.
- (U) \$3,461 Perform turbulence and flow control research to enhance air vehicle stability, performance, and control.
- (U) Investigate the use of MEMS devices on swept wing air vehicles. This research will allow for significant drag reduction at supersonic speeds resulting in increased vehicle range performance.
- (U) Develop MEMS actuators and sensors for micro-air vehicle systems. This research will allow micro-air vehicles and propulsion systems to operate in low-speed flight regimes.

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**1 - Basic Research****0601102F Defense Research Sciences****2307**

- (U) \$2,121 Conduct internal flow research to improve the performance and reliability/maintainability of airbreathing propulsion systems.
- (U) Develop MicroElectroMechanical Systems (MEMS) devices for turbine engine control. These devices will reduce and/or eliminate High Cycle Fatigue (HCF) problems in current airbreathing propulsion systems.
- (U) Develop Large Eddy Simulation (LES) methodology for turbomachinery flows. This research will decrease the design cycle time for new airbreathing propulsion systems.
- (U) \$7,212 Total

**(U) B. Program Change Summary (\$ in Thousands):**

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	11,107	13,294	13,489	Cost
	8,453	11,573	7,212	Cont
				Cont

**(U) Change Summary Explanation:**

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:****(U) Related Activities:**

- (U) PE 0602102F, Materials.
- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603211F, Aerospace Structures.

**(U) D. Schedule Profile: Not Applicable.**

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BUDGET ACTIVITY

1 - Basic Research

PE NUMBER AND TITLE

0601102F Defense Research Sciences

PROJECT

2308

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2308 Propulsion		10,075	9,830	18,675	19,524	19,765	20,078	20,470	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Efforts include space power and propulsion, airbreathing propulsion, and propulsion diagnostics. Research is focused on the efficient utilization of energy in airbreathing engines and chemical and non-chemical rockets. Research is organized into the areas of chemically reacting flow, non-chemical energetics. Chemically reacting flows involve complex coupling between energy release through chemical reaction and the flow processes which transport chemical reactants, products, and energy. Non-chemical energetic systems include plasma and beamed energy propulsion for orbit raising space missions and efficient ultra-high energy techniques for space-based energy utilization. Thermal management of space-based power and propulsion systems will be addressed.

(U) FY 1997 (\$ in Thousands):

- (U) \$4,060 Performed research on space and rocket propulsion and power.
- (U) Studied combustion instability in liquid-fueled rockets to achieve Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program goals.
- (U) Performed experimental and numerical investigation of plasma thrusters for orbit maneuvering and station keeping. Plasma thrusters provide high payload, affordable, and reliable propulsion alternatives for space operations.
- (U) Constructed a database of high-altitude rocket exhaust plume characteristics through experimental and numerical investigations. Database will enhance guidance algorithms and background scene generation for protection of space assets and capabilities.
- (U) \$5,355 Studied airbreathing combustion for propulsion systems including gas turbines for aircraft and scramjets for hypersonic flight capability.
- (U) Examined combustion product formation to minimize infrared signature in gas turbine engines and to comply with environmental regulation.
- (U) Investigated hydrocarbon fuel utilization in scramjets as a logistically supportable alternative to hydrogen fuel.
- (U) Investigated propulsion diagnostics for research, development, test, and evaluation of new propulsion system concepts.
- (U) Utilized planar laser-induced fluorescence to conduct time-resolved, multidimensional, multiparameter measurements to characterize fuel-air mixing and combustion efficiency in gas turbines and hypersonic propulsion systems.
- (U) Examined quantitative spectroscopic measurements in elevated pressures. Anticipates advanced gas turbine designs (Integrated High Performance Turbine Engine Technology (IHPTET) Phase III and beyond).
- (U) \$10,075 Total

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1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2308

## (U) FY 1998 (\$ in Thousands):

- (U) \$3,932 Perform research on space and rocket propulsion and power.
- (U) Examine rocket combustion instability to achieve third phase Integrated High Payoff Rocket Propulsion Technology (IHRPRT) program goals.
- (U) Investigate orbital station-keeping propulsion alternatives at micro- and nano- newtons thrust level for high-precision clusters of cooperating autonomous mini-satellite operations.
- (U) Experimentally and numerically investigate high-altitude rocket exhaust plume characterization to enhance database for guidance algorithms and background scene generation.
- (U) \$5,376 Study airbreathing combustion for propulsion systems including gas turbines for aircraft and scramjets for hypersonic flight capability.
- (U) Examine combustion product formation in gas turbine engines and explore supercritical fuel behavior under high temperature and pressure conditions, characteristic of future gas turbine engines and hypersonic propulsion systems.
- (U) Formulate new models for turbulence-chemistry interactions in combustion. Models are needed in computational algorithms for combustor design, such as the NASA National Combustor Design Code.
- (U) \$522 Investigate propulsion diagnostics for research, development, test, and evaluation of new propulsion system concepts.
- (U) Investigate high-speed image detection methods for propulsion system diagnostics such as planar laser-induced fluorescence.
- (U) Examine picosecond spectroscopic methods for measurements in high-pressure gas turbine combustors.
- (U) \$9,830 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$7,520 Perform research on space and rocket propulsion and power.
- (U) Model predictions of mini-satellite propulsion and performance for high-precision clusters of cooperating autonomous micro-satellite operations.
- (U) Develop supercritical combustion models for rocket propulsion to achieve next-generation, high thrust-to-weight ratio propulsion systems.
- (U) Perform experimental and numerical studies of high altitude ultraviolet (UV) and infrared (IR) signatures to protect space assets.
- (U) \$10,140 Study airbreathing combustion for propulsion systems including gas turbines for aircraft and scramjets for hypersonic flight capability.
- (U) Investigate the combustion chemistry of endothermic fuels to be used for thermal management in later phases of Integrated High Performance Turbine Engine Technology (IHPTET) gas turbine technology and in scramjets, leading to more efficient engines.
- (U) Study the coupling mechanisms between turbulence and liquid hydrocarbon fuel injection in gas turbine and scramjet engines to achieve enhanced fuel-air mixing and combustion efficiency.

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Exhibit R-2 (PE 0601102F)



## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
1 - Basic Research	0601102F Defense Research Sciences	February 1998	2308
<p>(U) (U) \$1,015 Investigate propulsion diagnostics for research, development, test, and evaluation of new propulsion system concepts.</p> <p>– (U) Research novel data reduction and interpretation approaches such as fractal analysis for quantitative image measurements in propulsion system environments.</p> <p>– (U) Extend diode-laser spectroscopic technique for onboard control of propulsion system operation and performance.</p> <p>– (U) \$18,675 Total</p>			
<b>(U) B. <u>Program Change Summary (\$ in Thousands):</u></b>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	10,686	11,293	11,359
	10,075	9,830	18,675
			Total
			Cost
			Cont
			Cont
<p>(U) Change Summary Explanation:</p> <p>Funding: Changes to this project since the previous President's Budget are due to increased emphasis on propulsion efforts within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>			
<b>(U) C. <u>Other Program Funding Summary:</u></b>			
(U) Related Activities:			
– (U) PE 0602102F, Materials.			
– (U) PE 0602203F, Aerospace Propulsion.			
– (U) PE 0602601F, Phillips Laboratory.			
– (U) PE 0603211F, Aerospace Structures.			
<b>(U) D. <u>Schedule Profile:</u></b> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2310

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
2310	Atmospheric Sciences	7,239	6,244	5,562	5,802	5,868	5,958	6,075	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Areas of emphasis include ionospheric research and meteorology. This research includes the physics, dynamics, and chemistry of processes that determine the structure and variability of the earth's atmosphere. Atmospheric properties such as wind, density, clouds and precipitation, ionization, and optical/infrared (IR) transmission/emissivity all affect the performance of Air Force systems. Research includes new measurement techniques and the development of models for specifying and predicting weather and other atmospheric conditions. Emphasis is placed on understanding fundamental atmospheric processes and their impacts on optical and IR weapon systems, and on understanding the dynamics and structure of the ionosphere that affect communications and surveillance systems. Major research efforts focus on ionospheric dynamics, mesoscale meteorology, triggered and natural lightning, cloud prediction, and models which define the optical structure of the atmosphere.

(U) FY 1997 (\$ in Thousands):

- (U) \$3,025 Conducted research on atmospheric modeling to enhance operational forecast capability.
- (U) Enhanced theoretical models of ionospheric dynamics describing processes that determine total electron concentration. Models will heighten forecast accuracy, minimizing disruptions to global radio communications and space surveillance.
- (U) Improved four-dimensional data assimilation techniques for integrating multispectral satellite data required for periodic updating of atmospheric models. These techniques facilitate highly accurate forecasts for aviation weather, which in turn limit adverse effects on precision-guided munitions (PGM) employment, and help identify optimum surveillance opportunities.
- (U) \$1,502 Analyzed atmospheric physics to understand and exploit the aerospace environment.
- (U) Profoundly improved techniques for remote sensing of the three-dimensional structure of cloud fields. Enables state-of-the-art prediction systems to determine precise weather limitations for surveillance and PGM employment.
- (U) Developed methodologies for WSR-88D Doppler radar which improve identification of turbulence, severe weather, and signal ambiguities, thus enhancing aviation safety and hazard avoidance.
- (U) \$2,712 Studied ionospheric physics to enhance global surveillance capability.
- (U) Examined natural and artificially-induced ducting phenomena in the equatorial ionosphere for increased understanding of their effects on global radio communications and space surveillance.
- (U) Investigated applications of Defense Meteorological Satellite Program (DMSP) observations to forecast equatorial spread-F (equatorial plasma depletion) events. Accurate prediction will reduce disruption of global radio communications and space surveillance.
- (U) \$7,239 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
1 - Basic Research	0601102F Defense Research Sciences	2310	
(U) FY 1998 (\$ in Thousands):			
- (U)	\$1,918	Conduct research on atmospheric modeling to enhance operational forecast capability.	
- (U)		(U) Identify crucial propagation modes through radio wave - space plasma interaction models. Enables diagnosis of ionospheric variability and minimizes disruptions to global communications and space surveillance.	
- (U)		(U) Model the structure of Kelvin-Helmholtz instabilities in stratified environments to show their effect on optical turbulence and propagation of laser radiation from airborne lasers.	
- (U)	\$1,309	Analyze atmospheric physics to understand and exploit the aerospace environment.	
- (U)		(U) Explore atmospheric electrification processes, focusing on hazards to space launch operations and optical characteristics of high altitude electric discharges, which affect global command and control capability and global radio communications and space surveillance.	
- (U)		(U) Improve satellite-based remote sensing of clouds, winds, visibility, relative humidity, and refractive index for airborne laser tactical use.	
- (U)	\$3,017	Study ionospheric physics to enhance global surveillance capability.	
- (U)		(U) Expand knowledge of gravity wave phenomena and density variations in the ionosphere and mesosphere, to improve forecasts of adverse effects on global radio communications and space surveillance.	
- (U)		(U) Enhance capability to observe and diagnose the ionosphere with portable radars and optical instrumentation, to limit disruption of global radio communications and space surveillance.	
- (U)	\$6,244	Total	
(U) FY 1999 (\$ in Thousands):			
- (U)	\$1,678	Conduct research on atmospheric modeling to enhance operational forecast capability.	
- (U)		(U) Enhance modeling and data analysis to couple ionospheric behavior with the neutral lower atmosphere and magnetospheric plasma. Superior models will significantly increase ability to forecast advance effects on global radio communications and space surveillance.	
- (U)		(U) Improve atmospheric radiative transfer models to more realistically estimate solar radiation impacts on cloud field dynamics to identify weather limitations on global surveillance and precision-guided munitions (PGM) employment.	
- (U)	\$263	Analyze atmospheric physics to understand and exploit the aerospace environment.	
- (U)		(U) Develop techniques using inverted Global Positioning System (GPS) data to determine vertical profiles of refractive index. Provides tactical decision aids to PGMs and the airborne lasers.	
- (U)		(U) Investigate gravity wave interaction with ambient atmospheric vorticity fields, producing "blini" (pancake) structures and optical turbulence, which degrade the propagation of laser radiation from airborne lasers.	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

**1 - Basic Research****0601102F Defense Research Sciences****2310**

- (U) \$3,621 Study ionospheric physics to enhance global surveillance capability.
- (U) Investigate ionosphere manipulation techniques using "heating radars" to artificially modify radio wave propagation for global radio communications and space surveillance.
- (U) Examine signatures of solar activity on ionospheric optical emissions, density variations, E-region dynamo currents, and ionization rates, which disrupt global radio communications and space surveillance.
- (U) \$5,562 Total

**(U) B. Program Change Summary (\$ in Thousands):**

(U) Previous President's Budget (FY 1998 PB)				Total
(U) Current Budget Submit/FY 1999 PB	FY 1997	FY 1998	FY 1999	Cost
	7,247	7,172	7,381	Cont
	7,239	6,244	5,562	Cont

**(U) Change Summary Explanation:**

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

**(U) C. Other Program Funding Summary:****(U) Related Activities:**

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603220C, Surveillance, Acquisition, Tracking, and Kill.

**(U) D. Schedule Profile: Not Applicable.**

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Exhibit R-2 (PE 0601102F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
1 - Basic Research		0601102F Defense Research Sciences								2311	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2311	Space Sciences	4,628	4,320	6,827	7,127	7,211	7,321	7,464	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> The objective of this project is to provide basic knowledge of the space environment and solar activity for the design and calibration of advanced Air Force systems relevant to operations in and through near-earth space. The project also supports the Air Weather Service (AWS) by improving observing and forecasting techniques that support operational military systems in space environments. Theoretical and empirical descriptions and models of the physics of the sun and the earth's magnetosphere, which are critical elements of future AWS prediction models and radiation belt codes, are being investigated.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$1,445 Analyzed physics of solar magnetic fields, solar flares and coronal mass ejections to provide a physical basis for predictive models of solar disturbance effects on near-earth space.</li> <li>- (U) Designed, constructed, and field-tested a spectrally tunable, near-infrared vector magnetograph to seek signatures of solar activity precursors. Ability to predict such occurrences yields advance notice to protect DoD space systems.</li> <li>- (U) Discovered presence of surface motion and strong vorticity signatures in solar active regions.</li> <li>- (U) \$1,426 Studied particle and interplanetary magnetic field properties of solar wind which transports solar disturbances to the earth's magnetosphere.</li> <li>- (U) Developed integrated circuit model to predict substorms in the magnetosphere when the interplanetary magnetic field has a southward polarity. Model will reduce calculation time for the Air Force specification and forecast model.</li> <li>- (U) Formulated theoretical model to predict creation of transpolar auroral arcs during periods of northward interplanetary magnetic field. Theoretical model will be used to evaluate performance of the Air Force specification and forecast model during times of changing interplanetary conditions.</li> <li>- (U) \$1,757 Performed study of magnetospheric and radiation belt processes to eliminate operational deficiencies caused by space weather effects.</li> <li>- (U) Developed a new model of inner magnetospheric electric fields to specify and forecast hazards to Air Force space systems.</li> <li>- (U) Analyzed satellite measurements to specify correlations between changes in convection patterns and the polarity of the interplanetary magnetic field. Analysis will enhance performance of Air Force communication systems at high latitudes.</li> <li>- (U) \$4,628 Total</li> </ul>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

1 - Basic Research

0601102F Defense Research Sciences

2311

## (U) FY 1998 (\$ in Thousands):

- (U)	\$1,273	Analyze physics of solar magnetic fields, solar flares and coronal mass ejections to provide a physical basis for predictive models of solar disturbances on near-earth space.
- (U)	\$1,741	<ul style="list-style-type: none"> <li>(U) Measure and quantify the time dependence of solar magnetic fields to determine topologies leading to solar flares and coronal mass ejections which can disrupt the earth's space environment.</li> <li>(U) Study the propagation and structure of coronal mass ejections in relation to the solar magnetic sector structure.</li> </ul>
- (U)	\$1,306	<ul style="list-style-type: none"> <li>Study magnetospheric and radiation belt processes to eliminate operational deficiencies caused by space weather effects.</li> <li>(U) Examine the response of energetic particles in the inner magnetosphere to high-speed solar wind streams.</li> <li>(U) Investigate the propagation of electrons injected into the magnetosphere by space-based platforms.</li> </ul>
- (U)	\$4,320	<ul style="list-style-type: none"> <li>Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the earth's magnetosphere.</li> <li>(U) Analyze and model the propagation of solar wind shock waves from a solar-wind sensor in space.</li> <li>(U) Study the coupling between the solar wind interplanetary magnetic field and the earth's magnetosphere by using solar-wind and near-earth satellites to analyze the solar wind ions that penetrate the magnetosphere.</li> </ul>
- (U)	\$4,320	Total

## (U) FY 1999 (\$ in Thousands):

- (U)	\$1,815	Analyze the physics of solar magnetic fields, solar flares and coronal mass ejections to provide a physical basis for predictive models of the solar disturbances on near-earth space.
- (U)	\$2,167	<ul style="list-style-type: none"> <li>(U) Model the evolution and stability of solar active regions to predict the state of the interplanetary medium using solar magnetic field and coronal data.</li> <li>(U) Analyze coronal emission line data for variations that can be related to disturbances in the interplanetary medium.</li> </ul>
- (U)	\$2,845	<ul style="list-style-type: none"> <li>Study the particle and interplanetary magnetic field properties of the solar wind which transports solar disturbances to the earth's magnetosphere.</li> <li>(U) Evaluate techniques to study solar source regions and infer the magnetic structures of interplanetary disturbances.</li> <li>(U) Test solar wind shock detection algorithms and transition them to applied Air Force geospace programs.</li> </ul>
- (U)	\$6,827	<ul style="list-style-type: none"> <li>Study magnetospheric and radiation belt processes to eliminate operational deficiencies caused by space weather effects.</li> <li>(U) Study fluid and particle dynamics of the geomagnetic tail to determine criteria for substorm onset.</li> <li>(U) Model rapid variations in the interaction between the solar wind and magnetosphere using diffusion coefficients estimated from electric field propagation studies.</li> </ul>
- (U)	\$6,827	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>1 - Basic Research</b>	<b>0601102F Defense Research Sciences</b>	<b>2311</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>5,229</td> <td>4,962</td> <td>5,040</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>4,628</td> <td>4,320</td> <td>6,827</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	5,229	4,962	5,040	Cost	(U) Current Budget Submit/FY 1999 PB	4,628	4,320	6,827	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	5,229	4,962	5,040	Cost														
(U) Current Budget Submit/FY 1999 PB	4,628	4,320	6,827	Cont														
<p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to increased emphasis on space sciences efforts within the Science and Technology (S&amp;T) Program.            Schedule: Not Applicable.            Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0302101F, Geophysics.</li> <li>- (U) PE 0602702F, Command, Control, and Communications.</li> <li>- (U) PE 0603410F, Space System Environmental Interactions.</li> </ul>																		
<p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 1 - Basic Research

## 0601102F Defense Research Sciences

2312

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2312 Biological Sciences	12,241	13,917	13,065	13,654	13,821	14,036	14,312	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project consists of two research areas: biodegradation and the toxicology of biohazards; and chronobiology and neural adaptation. Understanding how microbes degrade Air Force chemicals will enable the development of efficient and cost-effective strategies for cleaning up Air Force bases and preventing exposure to hazards due to Air Force operations. Likewise, knowledge of the mechanisms by which Air Force chemical and physical (lasers and microwaves) agents produce toxic effects will enable the development of safety assessment strategies and technologies to ensure the hazard-free development and use of future aerospace materials and systems. Basic research in neuroscience and chronobiology will result in new strategies to prevent G-induced loss of consciousness in pilots, impaired performance due to jet-lag and shift-work, night operations, and the loss of life and aircraft due to stress, inattention, or lack of vigilance.

## (U) FY 1997 (\$ in Thousands):

- (U) \$796 Performed generic basic research in biological sciences for Air Force applications.
- (U) \$6,059 Studied biodegradation and toxicology of biohazardous agents.
- (U) Cloned genes that encode for the microbial enzymatic degradation of tri-nitro-toluene (TNT) for eventual use in cleaning up military bases.
- (U) Recommended national safety standards for protecting the eye from exposure to single ultrashort laser pulses.
- (U) Described cellular and biochemical effects of a natural neuropeptide (substance P) in protecting immune system from inhalation exposure to JP-8 jet fuel.
- (U) \$5,386 Investigated mechanisms responsible for circadian rhythmicity to increase safety during night operation.
- (U) Determined that exercise shifts the biological clock, therefore, appropriately timed exercise will partially compensate for jet lag.
- (U) Clarified interaction between serotonin and light input to biological clock.
- (U) \$12,241 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
0601102F Defense Research Sciences 2312

## 1 - Basic Research

## (U) FY 1998 (\$ in Thousands):

- (U) Study biodegradation and toxicology of biohazardous agents.
- (U) Explore molecular biological mechanisms for expanding and controlling the genetic capacity of microbes to enzymatically degrade a wider range of military contaminants.
- (U) Examine the biological effects from exposure to multiple ultrashort laser pulses and radiofrequency.
- (U) Investigate toxic and protective mechanisms related to JP-8 jet fuel exposures.
- (U) Investigate biological mechanisms responsible for circadian rhythmicity.
- (U) Investigate chemistry of circadian clock to develop procedures and interventions to improve performance during night operations.
- (U) Explore circadian system plasticity to identify methods of jet lag prevention and reduction.
- (U) Conduct research on animal sensing systems.
- (U) Study natural-world infrared-sensitive systems for insights leading to military applications including space sensors.
- (U) Total

## (U) FY 1999 (\$ in Thousands):

- (U) Study biodegradation and toxicology of biohazardous agents.
- (U) Use molecular biological techniques developed for modifying microbial enzyme capacity to engineer the bio-catalysis of reactions involved in the synthesis and manufacture of developmental military materials.
- (U) Develop mathematical model to predict retinal damage from exposure to multiple ultrashort laser pulses of military importance.
- (U) Investigate molecular and biochemical effects in the brain and the neurobehavioral correlates associated with the inhalation of JP-8 jet fuel.
- (U) Investigate biological mechanisms responsible for circadian rhythmicity.
- (U) Examine individual differences in circadian systems to predict effects of night operations and jet lag on military personnel.
- (U) Continue research in mechanisms of animal sensing systems.
- (U) Investigate insect infrared systems for insights leading to military applications including space sensors.
- (U) Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 1 - Basic Research

0601102F Defense Research Sciences

2312

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	15,391	15,986	16,119	Cost
(U) Current Budget Submit/FY 1999 PB	12,241	13,917	13,065	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

1 - Basic Research

PE NUMBER AND TITLE

0601102F Defense Research Sciences

PROJECT

2313

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2313 Human Performance	8,729	7,877	12,567	13,133	13,292	13,500	13,764	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project provides fundamental knowledge of information processing in humans and other complex organisms needed to advance technologies for autonomous systems, command and control, human systems integration, and personnel selection and training. Research on sensory systems impacts technologies of computer image and speech processing, human interface, sensors and sensor fusion. Research on cognitive and perceptual processes impacts technologies of selection, education and training, command and control, and adaptive autonomous systems. Supported areas of research include Sensory Systems, with emphasis on vision and hearing, Cognition, Perception, Intelligent Tutors, and Team Situational Awareness.

(U) FY 1997 (\$ in Thousands):

- (U) \$2,416 Performed sensory and perceptual system analysis for human machine interface and image exploitation.
- (U) Discovered new technique for fusing multi-spectral images for visual display.
- (U) Devised new algorithm for computing scene depth from active focus control. Applications include robotics, surveillance, and targeting.
- (U) Established new, image processing filters based on human-image processing. Enhances image compression in communications and image segmentation in automatic target recognition.
- (U) Completed laboratory demonstration of performance enhancement aided by three-dimensional auditory cueing. Improves active visual search in aircraft and improves speech communication in command and control.
- (U) \$3,478 Conducted cognitive workload analysis for crew training and performance enhancement.
- (U) Completed preliminary cognitive task analyses for uninhabited air vehicle (UAV) mission control and command and control team research environments.
- (U) Determined benchmark task sets for mission control and command and control teams.
- (U) Created new software tool for faster, more formal, cognitive task analyses.
- (U) Discovered objective technique for cognitive workload assessment in human machine interface and training.
- (U) \$2,835 Studied synthetic task environments for baseline performance measurement.
- (U) Created apparatus for laboratory performance assessment of UAV mission control.
- (U) Established synthetic task environment for laboratory performance assessment of command and control teams.
- (U) Completed initial configuration of multi-ship flight simulator for performance and training assessment.
- (U) \$8,729 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

1 - Basic Research

0601102F Defense Research Sciences

PROJECT

2313

(U) FY 1998 (\$ in Thousands):

- (U) \$2,101 Perform sensory and perceptual system analysis for human-machine interface and image exploitation.
- (U) Examine human ability to detect and discriminate structure in complex images. Enhances image exploitation and targeting technologies.
- (U) Study human perception of false coloration in multi-spectral image displays. Improves interfaces for multi-spectral image acquisition systems.
- (U) Explore human ability to localize sounds in the near field, to improve communications in command and control. Conduct cognitive workload analysis for crew training and performance enhancement.
- (U) \$3,025 Develop models and improve theory of individual cognitive performance in decision making. Enhances technologies for high-tempo operations.
- (U) Develop models to predict impact of intelligent job-aiding technologies on overall performance of command and control teams.
- (U) Create framework and experimental techniques for titrating multiple effects of ability, training, interface, and environment on workload in complex settings.
- (U) \$2,751 Study synthetic task environments for baseline performance measurement.
- (U) Establish quantitative models of cognitive performance in scripted uninhabited air vehicle (UAV) mission control tasks.
- (U) Determine sensitivity of command and control teams to increased task demands, mitigated by job aiding and other performance enhancement technologies.
- (U) Establish performance criteria for multi-ship simulation environments.
- (U) \$7,877 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$3,460 Perform sensory and perceptual system analysis for human-machine interface and image exploitation.
- (U) Develop image representation theory using cues of color, motion, texture, and stereo for improved image display and human image exploitation technologies.
- (U) Investigate algorithms for visual attention that incorporate eye movement patterns. Improves performance assessment in command and control environments.
- (U) Support model-based predictions of limits in speech communication to improve three-dimensional audio display technologies.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

## February 1998

PE NUMBER AND TITLE

0601102F Defense Research Sciences

2313

- |       |          |                                                                                                                                                                                                                              |
|-------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) | \$4,980  | Conduct cognitive workload analysis for crew training and performance enhancement.                                                                                                                                           |
| -     |          | (U) Examine cognitive performance models for real-time workload measurement to improve technologies employed in the training and the amelioration of cognitive overload -- key elements of command and control environments. |
| -     |          | (U) Develop theory of cognitive workload including multiple dimensions that affect individual workload. Enhances modeling and simulation technologies.                                                                       |
| -     |          | (U) Extend cognitive models to include characterization of on-line job aiding systems used in synthetic, laboratory, command and control environments.                                                                       |
| - (U) | \$4,127  | Study synthetic task environments for baseline performance measurement.                                                                                                                                                      |
| -     |          | (U) Conduct experiments leading to more general theory of utility for performance enhancement techniques, as anticipated for uninhabited air vehicle (UAV) mission control.                                                  |
| -     |          | (U) Extend experimental techniques for command and control team performance, including constellations of small teams.                                                                                                        |
| -     |          | (U) Develop multi-ship modeling for UAV surveillance and targeting.                                                                                                                                                          |
| - (U) | \$12,567 | Total                                                                                                                                                                                                                        |

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

1 - Basic Research

0601102F Defense Research Sciences

2313

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	8,738	9,057	9,190	Cost
	8,729	7,877	12,567	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to increased emphasis on human performance efforts within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602702F, Command, Control, and Communication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
1 - Basic Research		0601102F Defense Research Sciences								4113	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4113	Science and Engineering Education Programs	12,800	15,102	13,285	13,902	14,079	14,305	14,586	Continuing	Continuing	

(U) A. Mission Description and Budget Item Justification: This project stimulates scientific and engineering education and increases the interaction between the broader research community (including the international science and engineering) and the Air Force laboratories. Emphasis is placed on increasing the number of U.S. citizens, especially women and minorities, with advanced degrees in science and engineering. These programs include: the Summer Faculty Research Program under which selected university faculty members conduct research at Air Force labs; the Graduate Student Research Program where graduate students in areas of interest to the Air Force perform research at Air Force labs; the University Resident Research Program where faculty members spend one year at an Air Force lab contributing to Air Force research needs and operations; the U.S. Air Force National Research Council (NRC) Resident Research Associateship Program which provides outstanding post-doctoral and senior scientists and engineers opportunities to research problems of their own choice that are compatible with the research interests of selected Air Force labs; the Laboratory Graduate Fellowship Program which is designed to stimulate doctoral candidate interest in Air Force labs and the research programs of those labs; and the National Defense Science and Engineering Graduate Fellowship Program which is jointly sponsored by the Army, Navy, Air Force, the Defense Advanced Research Projects Agency for the purpose of increasing the number of U.S. citizens trained in science and engineering, and various international programs such as Windows on Science which provides insight and experience in international research.

(U) FY 1997 (\$ in Thousands):

- (U) \$2,816 Funded international science and personnel exchange programs and technology liaison mission in Europe and Asia.
- (U) Supported nine Air Force scientists and engineers in European government laboratories, under the Engineer and Scientist Exchange Program (ESEP) program. Participants gain valuable experience performing research with foreign counterparts.
- (U) Provided the Air Force share of funding for the Von Karman Research Institute, which researches technologies of special NATO concern.
- (U) Provided funding for the European Office of Aerospace Research and Development (EOARD) office in London and the Asian Office of Aerospace Research and Development (AOARD) office in Tokyo to perform technology liaison missions as well as to establish contact with foreign centers specializing in emerging technologies of critical Air Force interest.
- (U) \$7,424 Supported science and technology personnel exchange within the United States.
- (U) Funded 189 faculty and 97 students for 12 weeks of research at Air Force labs, focusing on critical Air Force technology areas.
- (U) Supported the University Residence Research Program by funding sabbaticals at Air Force labs for 29 university researchers.
- (U) Provided funding for short-term appointments of Air Force Research Laboratory researchers to commercial and university laboratories. Participants gain valuable experience with industry and academic counterparts doing research in Air Force-related technologies.

Project 4113

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

1 - Basic Research

0601102F Defense Research Sciences

4113

- (U) \$2,560 Conducted fellowship awards program and roundtable on national science and technology policy.
- (U) Supported a roundtable of senior leaders from industry, government, and academia to formulate a national science and technology policy.
- (U) Provided awards to 50 outstanding university research scientists to pursue critical research at selected Air Force Research Laboratory (AFRL) locations.
- (U) \$12,800 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$4,983 Fund international science and personnel exchange programs and technology liaison mission in Europe and Asia.
- (U) Support scientists and engineers performing laboratory research in foreign countries.
- (U) Provide Air Force share of funding for NATO-affiliated research institute.
- (U) Fund European Office of Aerospace Research and Development (EOARD) and Asian Office of Aerospace Research and Development (AOARD) detachments to provide technology liaisons with Europe and Asia.
- (U) \$5,923 Support science and technology personnel exchange within the United States.
- (U) Support the summer faculty and graduate student research programs.
- (U) Provide funding for university researchers on sabbatical at Air Force labs.
- (U) Send AFRL researchers on short-term exchange programs to industry and academia.
- (U) \$4,196 Conduct fellowship awards program and roundtable on national science and technology policy.
- (U) Support roundtable of senior leaders from industry, government, and academia to formulate a national science and technology policy.
- (U) Provide funding for outstanding university research scientists to pursue research in selected areas at appropriate AFRL laboratories.
- (U) \$15,102 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$4,384 Fund international science and personnel exchange programs and technology liaison mission in Europe and Asia.
- (U) Support scientists and engineers performing laboratory research in foreign countries.
- (U) Provide Air Force share of funding for NATO-affiliated research institute.
- (U) Fund EOARD and AOARD detachments to provide technology liaisons with Europe and Asia.
- (U) \$5,210 Support science and technology personnel exchange within the United States.
- (U) Support the summer faculty and graduate student research programs.
- (U) Provide funding for university researchers on sabbatical at Air Force labs.
- (U) Send AFRL researchers on short-term exchange programs to industry and academia.

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 1 - Basic Research

0601102F Defense Research Sciences

4113

- (U) \$3,691 Conduct fellowship awards program and roundtable on national science and technology policy.
- (U) Support roundtable of senior leaders from industry, government, and academia to formulate a national science and technology policy.
- (U) Provide funding for outstanding university research scientists to pursue research in selected areas at appropriate Air Force Research Laboratory laboratories.
- (U) \$13,285 Total

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	15,143	17,347	17,600	Cost
	12,800	15,102	13,285	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0601103D, University Research Initiative.

(U) D. Schedule Profile: Not Applicable.

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Exhibit R-2 (PE 0601102F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
2 - Applied Research		0602102F Materials									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		75,448	69,339	62,578	63,927	70,330	69,118	68,270	Continuing	Continuing	
4347 Materials for Structures, Propulsion, and Subsystems		48,987	41,959	42,017	45,151	49,581	48,852	47,550	Continuing	Continuing	
4348 Materials for Electronics, Optics, and Survivability		12,788	13,323	5,509	3,221	3,824	3,782	3,840	Continuing	Continuing	
4349 Materials Technology for Sustainment		13,673	14,057	15,052	15,555	16,925	16,484	16,880	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program is the primary source of advanced materials and processes to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. Structural, propulsion, and sub-systems materials and processes are developed for aircraft, missile, space, satellite, and launch systems applications. Electronic and optical, advanced electromagnetic, and laser protection materials and processes are developed for application in Air Force aircraft, missile, space, and personnel protection systems. Advanced nondestructive materials evaluation methods, materials design data, pollution prevention materials, materials failure analysis, and materials repair methods are developed to improve the sustainment of Air Force systems for the current and future warfighters. Note: In FY 1997, Congress added \$7.5 million and \$1 million for composite materials research and advanced paint systems, respectively. In FY 1998, Congress also added \$2.0 million and \$1.0 million for composite aircraft shelters and inorganic/organic optical limiters, respectively, which explains the perceived decrease in FY 1999. In FYs 1999 and out, additional emphasis has been placed on improved materials, space systems, and aging aircraft. Also, in FY 1999 and emphasis has been reduced in electro-optical materials and processing development for aircraft specific applications.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602102F Materials

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	77,877	70,224	74,503	
(U) Appropriated Value	80,860	73224		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,766	-2,915		
b. SBIR	-1,094	-970		
c. Omnibus/Other Above Threshold Reprogrammings	-2,440			
d. Below Threshold Reprogrammings				
e. Rescissions	-112			
(U) Adjustments to Budget Year Since FY 1998 PB			-11,925	
(U) Current Budget Submit/FY 1999 PB	75,448	69,339	62,578	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to Congressional additions and higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602102F Materials

PROJECT

4347

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4347 Materials for Structures, Propulsion, and Subsystems	48,987	41,959	42,017	45,151	49,581	48,852	47,550	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops materials technologies for aircraft, spacecraft, and missiles with improved affordability, maintainability, and enhanced performance of current and future Air Force systems. Advanced thermal protection and carbon-carbon (C-C) composites materials are developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet the requirements of aircraft, spacecraft, missiles, and ballistic reentry systems. A family of affordable lightweight materials are developed, including metals, metallic and nonmetallic composites, and ceramics which can provide upgraded capability for existing aircraft, spacecraft, missile, and propulsion systems to meet the requirements for new systems beyond the year 2000. Included are turbine engine materials with operating capabilities from 1700°F to 2800°F that will enable engine designs to double the thrust to weight of 1986 engine performance capabilities. Spacecraft material technologies are developed that are lightweight, dimensionally stable, noncontaminating, and resistant to the space environment. Alternative or replacement materials are developed to maintain the performance of aging operational reentry systems. Fluids, lubricants, seals, coatings, and other nonstructural material technologies are developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems

(U) FY 1997 (\$ in Thousands):

- (U) \$8,979 Develop C-C and thermal protection material (TPM) technologies to improve operational capability of strategic and tactical systems.
- (U) Conducted ground test validation of alternate/replacement heatshield and antenna window materials and fabricated flight test articles to maintain the operational Intercontinental Ballistic Missile (ICBM) fleet.
- (U) Conducted evaluation of operational reentry vehicle heatshields which have been in service.
- (U) Identified and evaluated a cost reducing one step C-C process for electronic packaging applications in aircraft and spacecraft.
- (U) \$6,941 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.
- (U) Completed laboratory demonstration of polyalphaolefin (PAO)-based coolant with improved temperature stability and dielectric performance for Air Force airborne radar systems.
- (U) Identified advanced lubricants and coating system technologies for application in aging aircraft and spacecraft.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602102F Materials

PROJECT

4347

- (U) \$16,544

Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.

- (U) Published a composite patch design guide focusing on adhesively bonded materials and processing issues for the repair and life extension of aging aircraft.

- (U) Demonstrated the viability of high modulus polymeric composites for lightweight spacecraft structural applications.

- (U) Developed highly active paint-compatible fluorescent dyes for 3D imaging (NDE) of multiple coating layers and sensor protection. Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.

- (U) \$8,314

- (U) Completed material validation of SiC/Ti-6242 titanium metal matrix composite (Ti MMC) material for use in actuator rods for engine thrust vectoring nozzles.

- (U) Identified and characterized the application potential of an advanced titanium metal matrix composites (Ti MMC) for use in next-generation gas turbine engines.

- (U) Investigated compositional effects on the environmental and creep resistance of niobium and molybdenum intermetallic alloys.

- (U) Accomplished scale-up metal processing and ingot melting for isotropic aluminum-lithium.

- (U) Identified and evaluated permanent mold thin wall casting processes for turbine engines that can reduce the cost of these composites by 40% of today's cost.

- (U) \$8,209

Develop ceramic matrix composites, an understanding of material response to service life environments, and characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.

- (U) Developed repair materials for low-observable and other ceramic composite structures.

- (U) Conducted initial high cycle fatigue (HCF) evaluations of titanium alloy to provide guidance on resolving HCF issues with existing and future Air Force turbine engines.

Total

- (U) \$48,987

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602102F Materials	4347	
(U) FY 1998 (\$ in Thousands):			
- (U) \$7,970	Develop Carbon-Carbon (C-C) and thermal protection material (TPM) technologies to improve operational capability of strategic and tactical systems.		
	<ul style="list-style-type: none"><li>- (U) Develop alternate/replacement nosetip and heatshield materials for ballistic missile flight test evaluation.</li><li>- (U) Develop Global Positioning System antenna window materials with improved durability for ballistic missile flight test evaluation.</li><li>- (U) Establish baseline criteria for assessment of the aging affects on materials from operational reentry vehicle heatshields which have been in service.</li><li>- (U) Develop and test properties of a one step C-C process for aircraft and spacecraft electronic materials packaging applications.</li><li>- (U) Deliver alternate/replacement heatshield and antenna window materials for flight test.</li><li>- (U) Identify advanced thermal protection system material needs for future Air Force Transatmospheric Vehicles.</li></ul>		
- (U) \$6,017	Develop nonstructural materials (such as fluids, lubricants, seals, greases and coatings) for improved system performance, reduced toxicity, and reduced life cycle costs.		
	<ul style="list-style-type: none"><li>- (U) Identify and evaluate materials for improved aircraft paint systems for reduced maintenance and demonstrate low glint, low-observable coating treatments for Air Force systems.</li><li>- (U) Evaluate, develop, and provide materials data to transition long life hydraulic fluid seals for aging aircraft systems.</li><li>- (U) Develop advanced lubricants and coating system technologies for application in spacecraft moving mechanical assemblies.</li></ul>		
- (U) \$11,427	Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.		
	<ul style="list-style-type: none"><li>- (U) Identify and evaluate processing techniques that will minimize residual stresses in organic matrix composites without adversely affecting mechanical or physical properties.</li><li>- (U) Develop and demonstrate high modulus/thermally conductive polymeric composites for lightweight spacecraft structural applications.</li><li>- (U) Develop three-dimensional (3-D) failure criteria for the prediction of the initial failure and progressive damage in bonded and bolted composite joints by coupling nondestructive damage observations with 3-D spline variation stress analysis.</li><li>- (U) Complete computer computational simulations to guide efforts to prepare new organic polymers for flat panel displays, photovoltaic and sensor technologies.</li><li>- (U) Evaluate two-dimensional (2D) molecules for power limiting and imaging applications.</li><li>- (U) Prepare stable n-doped polymers for shielding and charge protection in air and space systems.</li></ul>		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
4347

## 2 - Applied Research

## 0602102F Materials

- (U) \$8,326 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.
- (U) Demonstrate titanium metal matrix composite (Ti MMC) actuator rods for advanced turbine engines.
- (U) Demonstrate processing techniques for producing isotropic aluminum lithium (Al-Li) thick plate products from 15,000 pound ingots. Application of this material in space launch vehicles instead of current aluminum alloys is expected to result in a 10-20% weight reduction.
- (U) Develop permanent mold thin wall casting processes that can reduce the cost of these high temperature components by 40% of today's cost.
- (U) Characterize orthorhombic metal matrix composites (MMCs) and gamma titanium aluminide (TiAl) in preparation for engine testing a bladed ring (bling) containing both materials.
- (U) Investigate the effect of processing methods on the properties of niobium and molybdenum intermetallic alloys.
- (U) Investigate the shape-making potential of different processes assuming the most creep resistant, oxidation resistant alloys.
- (U) Develop ceramic matrix composites; develop an understanding of material response to service life environments, and characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.
- (U) Develop ceramic matrix composite for space applications.
- (U) Develop repair materials and techniques for low-observable and other ceramic composite structures.
- (U) Continue detailed high cycle fatigue (HCF) evaluations of titanium alloy to provide guidance on resolving HCF issues with existing and future Air Force turbine engines.
- (U) \$41,959 Total
- (U) FY 1999 (\$ in Thousands):
- (U) \$8,296 Develop Carbon-Carbon (C-C) and thermal protection material (TPM) technologies to improve operational capability of strategic and tactical systems.
- (U) Demonstrate alternate/replacement heatshield materials ready for ballistic missile flight test evaluation.
- (U) Demonstrate reduced processing time and cost of one step or other low-cost C-C process for thermal management applications in aircraft and spacecraft.
- (U) Identify and evaluate concepts for replacement/qualification of aging materials for life management and life extension of operational reentry vehicles.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602102F Materials	4347	
- (U) \$6,261	Develop nonstructural materials (such as fluids, lubricants, seals, greases and coatings) for improved system performance and reduced life cycle costs.		
	- (U) Develop improved durability high temperature (450°F) ester-based gas turbine engine lubricant for application to existing aircraft propulsion systems.		
	- (U) Develop materials and processes to replace electrolytically deposited chromium and cadmium on aircraft bearings and fasteners which will improve friction and wear properties.		
	- (U) Develop space-qualified thermal control coatings to lightweight, durable, long life spacecraft radiators.		
	- (U) Identify a thermoplastic hot melt glue gun approach for conductive gap treatments.		
	- (U) Identify potential candidate corrosion inhibitors for Air Force coating systems.		
- (U) \$9,515	Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.		
	- (U) Develop processing techniques that will minimize residual stresses in organic matrix composites without adversely affecting mechanical or physical properties.		
	- (U) Demonstrate lightweight deployable composite radiator for spacecraft.		
	- (U) Evaluate polymer processing techniques for composites such as the two-photon curing process as a mode of low energy cure for resins and composites.		
	- (U) Synthesize novel polymer structures for electronic conductivity applications in advanced Air Force systems.		
	- (U) Extend the three-dimensional (3-D) spline variational elastic laminate technology (SVELT) stress model to incorporate the effect of environmental exposure in predicting failure initiation and progressive damage in bonded and bolted composite joints.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602102F Materials	4347	
- (U) \$9,613	Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.		
	- (U) Transition orthorhombic titanium metal matrix composites (MMCs) and gamma titanium aluminides to propulsion technology demonstrator programs for use in critical compressor rotating hardware.		
	- (U) Develop friction stir welding techniques for joining isotropic aluminum lithium (Al-Li) as might be done in producing large structural components for space launch vehicles.		
	- (U) Demonstrate permanent mold thin wall casting processes for turbine engines that can reduce the cost of titanium components by 40% of today's cost.		
	- (U) Evaluate the feasibility of producing gamma titanium aluminide (TiAl) sheet material with an attractive balance of properties for potential weight savings in future spacecraft hot nozzle structures.		
	- (U) Develop intermetallic alloys with the potential for achieving a +200°F temperature increase over current nickel-base superalloy turbine blade materials.		
	- (U) Develop investment and permanent mold casting methods of an advanced high-strength, high-toughness titanium alloy, Ti-62222, for airframe structures.		
- (U) \$8,332	Develop ceramic matrix composites; develop an understanding of material response to service life environments, and characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.		
	- (U) Demonstrate materials and techniques for repair of low-observable and other ceramic composite structures.		
	- (U) Complete assessment and develop damage tolerant life prediction methods for high cycle fatigue (HCF) design of titanium alloy turbine engine fan and compressor blades which will resolve HCF issues with existing and future engines.		
	- (U) Initiate HCF tests of single crystal superalloys.		
	- (U) Scale-up ceramic matrix composites for space propulsion applications by manufacturing sub-elements.		
- (U) \$42,017	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602102F Materials

PROJECT

4347

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY1998 PB)	50,600	42,214	45,311	Cost
(U) Current Budget Submit/FY 1999 PB	48,987	41,959	42,017	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0603211F, Aerospace Systems.
- (U) PE 0603202F, Aeropropulsion Subsystem Integration.
- (U) PE 0603216F, Aeropropulsion and Power Technology.
- (U) DOD Metal Matrix Composite Steering Group.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602102F Materials								4348	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4348	Materials for Electronics, Optics, and Survivability	12,788	13,323	5,509	3,221	3,824	3,782	3,840	Continuing	Continuing	

(U) **A. Mission Description and Budget Item Justification:** Develops materials technologies for space sensor systems, radars and subsystems for aircraft, missile, and space applications. This project also develops new materials for protection of aircrews, sensors, aircraft, and space systems from laser threats. Radar modules, microwave devices, infrared (IR) detectors, and infrared countermeasures are used in target detection, electronic warfare, active aircraft protection, and communications. The performance of these systems is constrained by the quality and physical characteristics of these materials. Materials are developed in this project that enable radars and sensors with higher operating speeds, greater tunability, higher out put power, improved thermal management, (including higher operating temperatures), greater sensitivity, and extended dynamic range. The improved materials also increase production quality, increase yields and reduce costs for radar and sensor systems. Protection from lasers is dependent upon the power level and wavelength or color emanating from the laser device and the susceptibility of the material or system being lased. Additionally, protection schemes are dependent on other characteristics of the laser such as variability of the wavelength and mode of operation (continuous wave or pulsed). Materials are optimized to counter the most prominent threat wavelengths and new materials are developed to respond to emerging threat wavelengths and ultimately to reject laser energy independent of threat wavelengths.

(U) **FY 1997 (\$ in Thousands):**

- (U) \$7,344 Develop new materials and processes to provide improved operational capability for Air Force radar and space sensor systems
- (U) Demonstrated the feasibility of a high temperature superconducting (HTS) infrared detector (IR) material that would not require cryogenic cooling for specialized space applications.
- (U) Demonstrated enhanced operability and resolution of long wavelength Focal Plane Arrays (FPAs) for space imagery and tracking through the development of very low defect, high performance detector materials.
- (U) Identified improved growth processes for wide-bandgap materials.
- (U) \$4,294 Develop materials to enhance the survivability of aircrews against laser threats and heat seeking IR missiles.
- (U) Completed laboratory demonstration of first generation, nonlinear organic materials for protection of personnel eyes, viewing systems, and night vision devices.
- (U) Transitioned ZnGeP2 frequency conversion crystalline materials to Infrared Countermeasures (IRCM) program.
- (U) \$1,150 Develop materials to enhance the survivability of air and space sensor systems against laser threats.
- (U) Evaluated candidate mid-infrared nonlinear optical materials for switches and limiters for laser protection.
- (U) Evaluated tunable filter technologies for laser protection devices.
- (U) \$12,788 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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PE NUMBER AND TITLE

PROJECT

## 2 - Applied Research

0602102F Materials

4348

(U) FY 1998 (\$ in Thousands):

- Develop new materials and processes to provide improved operational capability for Air Force radar and space sensor systems
- (U) \$5,798 (U) Identify and evaluate optimum crystals and techniques for high-power wavelength conversion of carbon dioxide and other lasers for Infrared Countermeasure (IRCM) and related applications (e.g., remote sensing of chemical and biological agents).
  - (U) Develop growth processes for wide-bandgap (silicon carbide, SiC) semiconductor materials with low defect densities, larger diameters and reproducible compositional uniformity for radar applications.
  - (U) Develop high performance multispectral sensor materials for the detection of multiple, discrete wavelengths within the infrared spectrum by space based systems.
  - (U) Establish the design criteria for the development of alternative materials for infrared detection.
  - (U) Identify innovative materials solutions to infrared imaging of complex targets such as chemical, biological or deeply buried/heavily camouflaged threats, from space based systems.
- Develop materials to enhance the survivability of aircrews against laser threats and heat seeking infrared (IR) missiles.
- (U) \$5,905 (U) Identify second generation, nonlinear organic materials for protection of personnel eyes, viewing systems, and night vision devices.
  - (U) Identify and evaluate optimum crystals and techniques for high power wavelength conversion of carbon dioxide and other lasers for IRCM and related applications (e.g., remote sensing of chemical and biological agents).
- Develop materials to enhance the survivability of air and space sensor systems against laser threats.
- (U) \$1,620 (U) Develop mid-infrared nonlinear optical materials for switches and limiters for laser protection.
  - (U) Develop tunable filter technologies for laser protection devices.
- Total
- (U) \$13,323

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BUDGET ACTIVITY		PROJECT <b>4348</b>
<b>2 - Applied Research</b>		PE NUMBER AND TITLE <b>0602102F Materials</b>

  

(U) FY 1999 (\$ in Thousands):	
- (U) \$870	Develop new materials and processes to provide improved operational capability for Air Force radar and space sensor systems
-	(U) Develop efficient, high yield growth processes and surface preparation for wide-bandgap semiconductor materials (silicon carbide, SiC) for radar and related radio frequency (RF) applications.
-	(U) Develop multilayered multispectral infrared sensor materials for space applications that respond to combinations of wavelengths within spectral bands and between spectral bands.
-	(U) Investigate infrared detection using alternative materials (other than mercury cadmium telluride or extrinsic silicon) to minimize cryocooler requirements for space-based systems and verify the utility of the materials for very long wavelength detection; determine the flexibility of response of the alternative materials for other spectral regions.
-	(U) Study and evaluate innovative materials solutions to infrared imagery of complex targets such as chemical, biological or deeply buried/heavily camouflaged threats, from space-based systems.
- (U) \$3,866	Develop materials to enhance the survivability of aircrews against laser threats and heat seeking infrared (IR) missiles.
-	(U) Evaluate second generation, nonlinear organic materials for protection of personnel eyes, viewing systems, and night vision devices.
-	(U) Develop next generation optimum crystals and techniques for high-power wavelength conversion of laser sources for Infrared Countermeasure (IRCM) and related applications (e.g., remote sensing of chemical and biological agents).
- (U) \$773	Develop materials to enhance the survivability of air and space sensor systems against laser threats.
-	(U) Validate mid-infrared nonlinear optical materials for switches and limiters for laser protection.
- (U) 5,509	(U) Validate tunable filter technologies for laser protection devices.
-	Total

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BUDGET ACTIVITY

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## 2 - Applied Research

0602102F Materials

4348

(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	Total
(U) Previous President's Budget (FY 1998 PB)	13,007	13,981	13,698	<u>Cost</u>
(U) Current Budget Submit/FY 1999 PB	12,788	13,323	5,509	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) PE 0602202F, Armstrong Laboratory Exploratory Development.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603211F, Aerospace Systems.
- (U) Tri-Service Laser Hardening Materials and Structures Group.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602102F Materials

PROJECT

4349

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4349 Materials Technology for Sustainment		13,673	14,057	15,052	15,555	16,925	16,484	16,880	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops materials to provide operational support to Air Force mission areas by providing technologies to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing capability to detect and characterize performance threatening defects, eliminating the dependency on hazardous and toxic materials in repair and maintenance, and providing quick reaction support to the operational commands and repair centers. Non-destructive inspection/evaluation (NDI/E) methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, propulsion, and missile systems. NDI/E methods are essential to monitor and detect the onset of any service-initiated damage and/or deterioration. This project develops techniques that increase the capability and reliability of currently used methods to detect and characterize performance threatening defects in metallic and nonmetallic composite structures.

(U) FY 1997 (\$ in Thousands):

- (U) \$4,871 Develop NDI/E technologies to evaluate and characterize damage in complex, low-observable materials and structures. Develop NDI/E technologies to inspect and maintain integrity of aging aircraft and missile structures and aeropropulsion systems.
- (U) Identified and evaluated corrosion and crack detection characterization technologies for the inspection of airframe structures.
- (U) Demonstrated NDI/E technologies for the characterization of fiber-reinforced composite materials and structures.
- (U) Identified and evaluated NDI/E technologies for the characterization of low-observable materials and structures.
- (U) \$6,883 Develop support capabilities, information, and processes to resolve problems in the use of materials, or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures.
- (U) Demonstrated an advanced non-chromate treatment for corrosion resistance and surface hardening in aircraft structural materials.
- (U) Demonstrated technology for improved composite repairs and composite repairs on metals.
- (U) Demonstrated improved non-hazardous cleaning techniques for liquid oxygen lines and solid state electronics.
- (U) Evaluated technologies and material candidates for a biodegradable chaff.
- (U) Developed alternative paint/depaint technologies to reduce or eliminate volatile organic compounds.
- (U) Established in-house, high-frequency testing capability for aerospace structural materials.
- (U) Assessed material properties of a new materials for military engine applications.

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BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>2 - Applied Research</b>		<b>0602102F Materials</b>	<b>4349</b>

  

- (U) \$1,919	Develop alternative materials, processes and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance and repair on aerospace systems.
- (U) \$4,983	- (U) Demonstrated techniques for in place cleanliness measurements and develop laser based cleaning technology.
- (U) \$13,673	- (U) Developed coatings, coating/coating remove processes and surface treatments to reduce or eliminate Volatile Organic Compounds, Hazardous Air Pollutants, and the use of banned substances.
- (U) \$13,673	- (U) Developed materials and processes to replace hazardous plating operations.
- (U) \$13,673	Total

  

(U) FY 1998 (\$ in Thousands):

- (U) \$4,983 Non-destructive inspection/evaluation (NDI/E) methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, and launch systems. This area is developing NDI/E technologies evaluate and characterize damage in complex, low-observable materials and structures and NDI/E technologies to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) Demonstrate NDI/E technologies for the semi-automated characterization of fiber-reinforced composite materials and structures and identify capability to develop remote inspection within complex structures.
- (U) Develop corrosion and crack detection characterization technologies for the inspection of aging airframe structures.
- (U) Develop NDI/E technologies for the structural and electromagnetic characterization of low-observable materials and structures.



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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT 4349	
2 - Applied Research	0602102F Materials		
- (U) \$7,203	Develop support capabilities, information, and processes to resolve problems in the use of materials, or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures. Develop technical understanding of corrosion to model and reduce corrosion in aircraft structures. Assess emerging structures joining technologies for application to new alloys not currently weldable.		
	- (U) Define effects of corrosion through establishment of corrosion classification methodology and survey domestic and international industrial base to define most promising environmentally compliant coating technologies for corrosion prevention and control.		
	- (U) Develop new engineering specifications and or guidelines for selecting corrosion resistant alloys as material substitutes in aircraft structural applications.		
	- Validate high-frequency/high cycle fatigue testing capability for new aerospace structural materials.		
	- (U) Develop stir/solid-state welding for advanced aerospace structural alloys and participate with aerospace industry to assess new joining technologies for application to Air Force systems.		
	- (U) Support transition of phenolic coated fasteners and joining technology for use on large aircraft structures.		
	- (U) Evaluate materials and processes for repairs of high temperature composite structures and develop on-aircraft techniques for advanced surface treatments.		
	- (U) Provide quick reaction technical support in the areas of fluids, sealants, elastomers, adhesives, and composites to Air Force field units and Air Logistics Centers.		
- (U) \$1,871	Develop alternative materials, processes and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance and repair on aerospace systems.		
	- (U) Develop Sol-Gel technology as a surface treatment prior to coating and bonding operations, and evaluate the performance of surface treatment techniques which could replace chrome plating operations.		
	- (U) Develop laser-based technology for the precision cleaning of aerospace components.		
	- (U) Evaluate the performance of coatings, coating/coating removal processes and surface treatments developed to reduce or eliminate Volatile Organic Compounds, Hazardous Air Pollutants, and the use of banned substances.		
- (U) \$14,057	Total		

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(U) FY 1999 (\$ in Thousands):

- (U) \$5,315 Non-destructive inspection/evaluation (NDI/E) methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, and launch systems. This area is developing NDI/E technologies evaluate and characterize damage in complex, low-observable materials and structures, and NDI/E technologies to inspect and maintain integrity of aging aerospace structures and propulsion systems.
- (U) Demonstrate corrosion and crack detection characterization technologies for the inspection of aging airframe structures and develop capabilities for the detection of the onset of hidden corrosion.
- (U) Demonstrate NDI/E technologies for the structural and electromagnetic characterization of low-observable materials and structures and identify and evaluate NDI/E technologies to assess advanced technology low-observable coatings.
- (U) Identify and evaluate NDI/E technologies for the characterization of solid rocket motors and develop X-ray computed tomography and microtomography methods to complement metallographic and other materials and processes analysis techniques.
- (U) Identify/evaluate NDI/E techniques to provide process sensing capabilities information for enhanced control of aerospace materials processing.
- (U) \$7,670 Develop support capabilities, information, and processes to resolve problems in the use of materials, or in conducting failure analysis of components. Develop a materials database for transition of materials to aerospace systems. Maintain a handbook and develop guidelines for materials repair of aircraft structures. Develop technical understanding of corrosion to model and reduce corrosion in aircraft structures. Assess emerging joining structures technologies for application to new alloys not currently weldable.
- (U) Assess effects of corrosion to damage tolerance on materials / structures through testing on simple structures.
- (U) Develop test methodologies and industrial consensus standardization activities required to conduct and assess performance of environmentally compliant coatings.
- (U) Measure and characterize the threshold for fatigue propagation values for engine materials.
- (U) Assess and provide improvements for joining of new high performance alloys and transition joining techniques to industry and Air Logistics Centers while providing technical support on procedures and process control techniques.
- (U) Develop procedures for on-aircraft repair of high temperature composites and optimize and demonstrate advanced surface preparation technologies.
- (U) Provide quick reaction technical support in the areas of fluids, sealants, elastomers, adhesives, and composites to Air Force field, Air Logistics Centers, and System Program Offices.
- (U) \$2,067 Develop alternative materials, processes and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance and repair on aerospace systems.
- (U) Evaluate environmentally friendly coating and surface treatment processes and the use of laser based cleaning technology.
- (U) Evaluate the performance of materials and processes developed as alternatives to hexavalent chrome plating.
- (U) 15,052 Total

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602102F Materials	4349	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		14,270	15,029
(U) Current Budget Submit/FY 1999 PB		13,673	14,057
			FY 1999
			15,494
			15,052
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0603112F, Advanced Materials for Weapons Systems.			
- (U) PE 0603211F, Aerospace Structures.			
- (U) PE 0603211F, Aerospace Systems.			
- (U) Office of Science and Technology Committee Materials Working Group on Non-Destructive Materials.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
2 - Applied Research		0602201F Aerospace Flight Dynamics									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		62,507	57,446	64,932	63,212	63,305	63,780	67,491	Continuing	Continuing	
2401 Structures		15,228	15,642	17,644	18,028	18,438	18,308	18,848	Continuing	Continuing	
2402 Vehicle Equipment		11,177	9,932	11,836	7,762	7,362	7,404	7,835	Continuing	Continuing	
2403 Flight Controls and Pilot-Vehicle Interface		19,260	16,291	17,733	18,721	19,190	19,870	20,689	Continuing	Continuing	
2404 Aeromechanics and Integration		14,977	15,115	16,347	16,749	16,759	17,233	17,688	Continuing	Continuing	
4397 Air Base Technology		1,865	466	1,372	1,952	1,556	965	2,431	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Applied Research program determines the technical feasibility of air vehicle technologies in aeromechanics, structures, flight control, vehicle-pilot integration, vehicle subsystems, and air base operability to reduce life cycle costs and improve the performance of existing and future air vehicles, and the maintenance and survivability of air bases. The payoffs from these technology programs include: increased survivability, affordability, reliability, maintainability, and supportability for air vehicles and subsystems; improved air base operability; and safe air vehicle all-weather operations. Note: In FYs 1999 and out, additional emphasis has been placed on aerospace flight dynamics technologies that can be applied to prolonging the life of our aging aircraft fleet.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		
2 - Applied Research		February 1998
PE NUMBER AND TITLE		
0602201F Aerospace Flight Dynamics		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	62,934	60,509
(U) Adjustments to Appropriated Value	65,080	60,509
a. Congressional/General Reductions	-1,379	-2,461
b. SBIR	-661	-602
c. Omnibus/Other Above Threshold Reprogrammings		
d. Below Threshold Reprogrammings	-450	
e. Rescissions	-83	
(U) Adjustments to Budget Year Since FY 1998 PB		
(U) Current Budget Submit/FY 1999 PB	62,507	57,446
		-107
		64,932
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.		
(U) D. <u>Schedule Profile:</u> Not Applicable.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602201F Aerospace Flight Dynamics

PROJECT

2401

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	15,228	15,642	17,644	18,028	18,438	18,308	18,848	Continuing	Continuing
2401 Structures									

(U) **A. Mission Description and Budget Item Justification:** This project develops advanced aircraft structures; investigates new structural concepts and design techniques which exploit new materials and fabrication processes to strengthen and extend the life of air vehicle structures while reducing weight and cost; and develops "smart" structures that will have embedded sensors to report stress, fatigue, and/or battle damage, leading to improved maintainability.

(U) FY 1997 (\$ in Thousands):

- (U) \$523 Design, develop, and test advanced structures/concepts which incorporate distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance.
- (U) Conducted testing of embedded, distributed vibration suppression techniques for aircraft structures to enhance vehicle performance.
- (U) Conducted testing of "smart stiffness" wing warping concepts to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.
- (U) Developed scaling laws and procedures that incorporate "smart" structures techniques into full-scale aircraft structures which could lead to eliminating the need for discrete control surfaces.
- (U) \$2,228 Develop advanced structural concepts and design methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.
- (U) Designed, fabricated, and assessed advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures.
- (U) Developed initial analytical aeroelastic techniques and methods to provide design guidance for structural flutter clearance for new weapons/store configurations on existing aircraft in lieu of expensive flight testing.
- (U) \$11,131 Extend usable structural lives of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.
- (U) Developed corrosion analysis metrics to assess corrosion fatigue effects on inspection and maintenance intervals.
- (U) Developed crack growth analysis and preliminary probabilistic risk assessment techniques which incorporate widespread fatigue damage effects to better predict structural component service life.
- (U) Developed techniques to analyze bonded-composite repairs of metallic structures which eliminate the need for riveted/bolted metal repair patches.
- (U) Designed and developed weapon bay acoustic suppression techniques to increase the performance of current and future air vehicles.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>2 - Applied Research</b>	<b>0602201F Aerospace Flight Dynamics</b>	<b>2401</b>	
- (U) \$1,346	Improved durability for existing stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust.		
- (U) \$15,228	- (U) Developed concepts for low-observable ceramic composite exhaust structures of stealth vehicles that significantly increase life and decrease costs.		
- (U) \$2,109	- (U) Developed passive structural temperature control concepts to reduce infrared signature of current fleet.		
- (U) \$2,109	- (U) Developed active distributed vibration suppression techniques using embedded actuator design concepts for aircraft structural applications.		
- (U) \$2,109	- (U) Conduct wind tunnel and ground assessment tests of wing warping, camber shaping, and "smart stiffness" structural concepts to reduce aircraft weight, drag, and radar signature, and to alleviate fighter aircraft vertical tail buffet and fatigue damage.		
- (U) \$2,109	- (U) Evaluate scaling laws and procedures needed to incorporate "smart" structures techniques into full-scale aircraft structures and, thus, eliminate the need for discrete control surfaces.		
- (U) \$2,109	- (U) Develop advanced structural concepts and design methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.		
- (U) \$2,109	- (U) Design, fabricate, and assess advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures. Complete evaluation and assessment of cost benefits from applying full-scale, primary, composite sandwich structure fabrication methods to air vehicles.		
- (U) \$2,109	- (U) Exercise analytical techniques needed to provide design guidance for future use of active aeroelastic wings.		
- (U) \$2,109	- (U) Demonstrate integration of advanced methods in aerodynamics, controls, signatures, testing, manufacturing, etc. with structural design methods to facilitate more efficient development of aircraft systems.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**2 - Applied Research**

**0602201F Aerospace Flight Dynamics**

**PROJECT 2401**

- (U) \$11,440 Extend usable structural lives and/or reduce costs of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.
  - (U) Develop life prediction analysis techniques to assess corrosion fatigue effects on inspection and maintenance intervals.
  - (U) Develop mature probabilistic risk assessment techniques which incorporate widespread fatigue damage effects to better predict structural component service life.
  - (U) Further develop techniques to analyze bonded-composite repairs of metallic structures and to optimize repair design.
  - (U) Evaluate and assess weapon bay acoustic suppression techniques to increase the weapons delivery envelope of current and future air vehicles.
- (U) \$1,484 Improve durability for existing and future stealth vehicles structures operating in extreme environments such as temperature, noise, and vibration caused by engine exhaust.
  - (U) Evaluate floating deck concepts for low-observable ceramic composite exhaust structures of stealth vehicles that significantly increase life and decrease costs.
  - (U) Complete assessment of passive high performance ceramic matrix composite technology/concepts for exhaust washed structures.
  - (U) Develop active structural temperature control concepts to reduce infrared signature of current fleet.
- (U) \$15,642 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2401	
(U) FY 1999 (\$ in Thousands):			
- (U) \$800	Design, develop, and test advanced structures/concepts that incorporate distributed vibration suppression technologies for life extension and exploit wing warping, camber shaping, and adaptive structures technologies that enhance air vehicle performance.		
	- (U) Complete the evaluation and assessment of active distributed vibration suppression techniques using embedded actuator design concepts. Develop scaling laws and procedures needed to transition this technology to full-scale aircraft structures.		
	- (U) Continue evaluation and assessment of wing twisting and control surface warping structural concepts to reduce aircraft weight and drag and to increase maneuverability and survivability. Assess application of these design concepts and design procedures to inhabited and uninhabited combat air vehicles.		
	- (U) Develop advanced structural design concepts based on the established scaling laws, procedures, and concept testing that incorporate "smart" structures and materials into full-scale, multidisciplinary aircraft structures.		
- (U) \$3,407	Develop advanced structural concepts and multidisciplinary design optimization methods that will enhance affordability and survivability of upgraded, derivative, and future aircraft.		
	- (U) Correlate analytical methods with ground test data to provide guidance for future use of active aeroelastic wings.		
	- (U) Design, fabricate, and assess advanced composite structures technologies which demonstrate the potential for 30% manufacturing and 20% support cost savings while providing improved battle damage tolerance over existing structures. Complete evaluation and assessment of cost benefits of incorporating a survivable, decoupled fuel cell design into air vehicle structures.		
	- (U) Complete demonstration of integration of advanced methods in aerodynamics, controls, signatures, testing, manufacturing, etc. with structural design methods to facilitate more efficient development of aircraft systems.		
- (U) \$12,087	Extend usable structural lives and/or reduce costs of aging aircraft through proven techniques that account for life, risk, repairs, and dynamic loads.		
	- (U) Validate analysis methodology and metrics to assess corrosion fatigue effects on inspection and maintenance intervals and restoral strength.		
	- (U) Evaluate probabilistic techniques to assess risk of failure of structural component subject to widespread fatigue damage.		
	- (U) Validate repair design tool for bonded-composite repairs of metallic structures, eliminating riveted/bolted metal repair patches.		
	- (U) Demonstrate weapon bay preliminary active, acoustic suppression techniques to increase the performance envelope of current and future air vehicles and develop sonic fatigue damage and suppression techniques.		
- (U) \$1,350	Improve durability for existing and future aircraft structures by developing concepts that incorporate advanced materials as well as passive and active cooling to withstand the extreme environments of high temperatures, vibrations, and acoustic noise.		
	- (U) Design structurally integrated thermal energy management system and ceramic matrix composite components compatible with low-observable vehicles that significantly increase life and decrease costs.		
	- (U) Develop durable thermal protection systems using advanced materials to reduce operations and support costs.		
- (U) \$17,644	Total		

Project 2401

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Exhibit R-2 (PE 0602201F)

Project 2401

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Exhibit R-2 (PE 0602201F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602201F Aerospace Flight Dynamics

2401

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	15,698	16,604	17,999	Cost
	15,228	15,642	17,644	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602269F, Hypersonic Technology Development.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 2401

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Exhibit R-2 (PE 0602201F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602201F Aerospace Flight Dynamics

PROJECT

2402

COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2402	Vehicle Equipment	11,177	9,932	11,836	7,762	7,362	7,404	7,835	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops technologies to reduce subsystem and component life cycle costs, improve vehicle/crew member survival in operational environments, and improve subsystem performance for current and future flight vehicles.

(U) FY 1997 (\$ in Thousands):

- (U) \$3,099 Design, develop, and assess component damage repair technologies that increase air vehicle survivability.
- (U) \$2,881 Developed preliminary experimental techniques and analytical tools which define effects of various ballistic threats against a variety of structural components.
- (U) \$2,640 Design, develop, and assess subsystem technologies to enhance air vehicle protection and survivability.
- (U) \$2,557 Developed an abrasion-resistant coating for next generation injection molded transparencies to fabricate single-piece canopies for increased affordability and a factor of five reduction in life cycle costs.
- (U) \$11,177 Completed initial concept demonstrator for integrated subsystems design methodologies.
- (U) \$2,557 Developed the capability to conduct transparency tests that determine degradation of performance and supportability.
- (U) \$2,557 Developed approaches that alleviate transparency electrostatic discharge and reduce component degradation and life cycle costs.
- (U) \$2,557 Design, develop, and assess technologies for aircraft internal thermal energy management systems.
- (U) \$2,557 Completed initial concept demonstrator for integrated subsystems design methodologies.
- (U) \$2,557 Fabricated and tested thermal system composite material components to achieve 50% reduction in weight and size.
- (U) \$2,557 Designed and tested enhanced heat exchanger model to improve aircraft temperature control system performance.
- (U) \$2,557 Design, develop, and assess advanced landing gear concepts for improving performance and supportability of air vehicle subsystems.
- (U) \$2,557 Designed, developed, and assessed scientific methods for predicting and measuring landing gear stability.
- (U) \$2,557 Developed lightweight landing gear technology to gain overall aircraft performance and efficiency.
- (U) \$11,177 Total

Project 2402

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Exhibit R-2 (PE 0602201F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>	PROJECT <b>2402</b>
BUDGET ACTIVITY <b>2 - Applied Research</b>		PE NUMBER AND TITLE <b>0602201F Aerospace Flight Dynamics</b>	
(U) FY 1998 (\$ in Thousands):	<p>Design, develop, and assess component combat damage repair technologies, fire suppression techniques, hydrodynamic ram tolerance techniques, and critical component armoring techniques that increase air vehicle survivability.</p> <ul style="list-style-type: none"> <li>- (U) Develop mature experimental techniques and analytical tools to define and reduce effects of various missile and ballistic threats on critical structural components, vehicle fuel/fluid systems and internal munitions.</li> <li>- (U) Develop preliminary analytical models to predict air vehicle vulnerability and evaluate alternative techniques for vulnerability reduction.</li> <li>- (U) Establish the methodology for lightweight armoring of critical components.</li> <li>- (U) Define and evaluate models and criteria for sizing and selecting fire suppression techniques to use in engine nacelles, dry bays, cargo bays, and internal munitions bays.</li> </ul> <p>Design, develop, and assess subsystem technologies to enhance air vehicle protection and survivability.</p> <ul style="list-style-type: none"> <li>- (U) Establish the capability to conduct dust erosion tests for predicting transparency coating performance/durability degradation at speeds up to Mach 1.5.</li> <li>- (U) Demonstrate the methodology to verify the compliance of transparency designs with the electrostatic discharge damage protection criteria.</li> </ul> <p>Design, develop, and assess technologies for aircraft internal energy management systems.</p> <ul style="list-style-type: none"> <li>- (U) Define technologies and approaches which allow an assessment of aircraft subsystem energy interactions.</li> <li>- (U) Develop a detailed roadmap of modeling, methodologies, and technologies required for development of a capability for system-based design trade offs of air vehicle components, subsystems, and stores.</li> <li>- (U) Fabricate a full-scale advanced composite material heat exchanger; demonstrate 50% reduction in weight and size.</li> </ul> <p>Total</p>		
- (U) \$3,560			
- (U) \$2,938			
- (U) \$3,434			
- (U) \$9,932			

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602201F Aerospace Flight Dynamics</b>	PROJECT <b>2402</b>
(U) FY 1999 (\$ in Thousands):		
- (U) \$3,300	Design, develop, and assess component combat damage repair technologies, fire suppression techniques, hydrodynamic ram tolerance techniques, and critical component armoring techniques that increase air vehicle survivability.	
-	(U) Complete development of experimental techniques and analytical tools to define and reduce efforts of various missile and ballistic threats on critical structural components, vehicle fuel/fluid systems and internal munitions.	
-	(U) Develop mature analytical models to predict air vehicle vulnerability and to evaluate alternative techniques for vulnerability reduction.	
-	(U) Establish the criteria for evaluating alternative techniques for armoring of critical components.	
-	(U) Validate criteria and models for requiring, sizing, and selecting fire suppression techniques to use in engine nacelles, dry bays, cargo bays, and internal munitions bays.	
- (U) \$4,862	Develop and assess process for affordable structural life.	
-	(U) Conduct element and development testing for corrosion fatiguers predictive models, assess their utility in predicting structural integrity, life cycle and required intervals of inspection for corrosion affected components in existing aircraft structures.	
-	(U) Develop composite repair process for damaged and cracked components in existing aircraft structures.	
-	(U) Develop predictive model and repair techniques for widespread fatigue damage in existing aircraft structures.	
-	(U) Develop noise suppression techniques to reduce structural damage in weapons bays of existing aircraft.	
-	(U) Identify and develop new analysis methods and design criteria for advanced composite structures.	
- (U) \$3,674	Design, develop and assess technologies for aircraft internal energy management systems.	
-	(U) Develop breadboard for system-based design trade off of air vehicle components and subsystems.	
-	(U) Validate high efficiency aircraft thermal energy management system components	
-	(U) Evaluate and assess advanced heat transfer techniques based on electrohydrodynamic principles.	
- (U) \$11,836	Total	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602201F Aerospace Flight Dynamics

2402

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	11,192	10,421	10,880	Cost
(U) Current Budget Submit/FY 1999 PB	11,177	9,932	11,836	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to increased emphasis on flight vehicle equipment efforts within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603106F, Logistics System Technology.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) PE 0604212F, Aircraft Equipment Development.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602201F Aerospace Flight Dynamics								2403	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2403	Flight Controls and Pilot-Vehicle Interface	19,260	16,291	17,733	18,721	19,190	19,870	20,689	Continuing	Continuing	

(U) **A. Mission Description and Budget Item Justification:** This project develops technology to enable the pilot to obtain maximum performance from the aircraft under all conditions, provide the pilot with the display of information from on-board subsystems and off-board intelligence sources for increased situational awareness leading to enhanced mission performance and flight safety, provide robust capability to control aircraft after damage and failures, and network synthetic environments for evaluation of advanced concepts.

(U) FY 1997 (\$ in Thousands):

- (U) \$5,886 Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.
- (U) Continued developing advanced control concepts such as advanced actuators and wing flexing.
- (U) Developed central control system to support groups of manned and unmanned aircraft to increase mission effectiveness and attack options.
- (U) \$5,110 Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.
- (U) Selected and evaluated reconfigurable flight control techniques which allow battle damaged, reduced signature aircraft to fly safely.
- (U) Developed criteria and designed standards for flight control systems that prevent pilot-induced control problems and improve handling qualities.
- (U) \$4,727 Develop enhanced vehicle-pilot integration technologies to improve overall weapon systems performance and exploit real-time on-board/off-board data.
- (U) Developed vehicle-pilot integration capabilities allowing two-person, mobility and special operations cockpits to access threat intelligence information in-flight.
- (U) Developed vehicle-pilot integration technologies for single-seat fighter-bombers operating in high threat environments.
- (U) \$3,537 Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.
- (U) Developed techniques incorporating long distance networking to support modeling of close-in and high angle-of-attack air combat.
- (U) \$19,260 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2403	
(U) FY 1998 (\$ in Thousands):			
- (U) \$4,918	Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.		
	- (U) Continue developing advanced control concepts and advanced actuation development enabling reduced structural weight and cost while increasing survivability and decreasing logistical support.		
	- (U) Develop control strategies that enable interactive and cooperative flights of manned and unmanned aircraft to increase mission effectiveness, attack options, and all weather point-of-use delivery.		
	- (U) Develop risk reduction strategies and global operational analyses for advanced optical air data sensor development.		
	- (U) Develop open control system infrastructure that enables commercial processors and data busses in flight critical applications.		
- (U) \$4,236	Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.		
	- (U) Continue to develop design criteria and standards for flight control systems that prevent pilot induced control problems.		
	- (U) Start effort to update handling qualities handbook for use by the acquisition community.		
	- (U) Continue development of reconfigurable flight control techniques that allow battle damaged, reduced signature aircraft to fly safely.		
	- (U) Select and assess new methods that will improve prediction of non-linear aerodynamic modeling for use in design simulations.		
- (U) \$2,099	Develop control technologies for global range transport aircraft.		
	Develop enhanced vehicle-pilot integration technologies to improve overall weapon systems performance and exploit real-time on-board/off-board data.		
	- (U) Develop display format requirements for integrating in-flight mission planning and automated low-level flight.		
	- (U) Review operator mission requirements; assess availability/applicability of human-machine interface technologies.		
- (U) \$3,261	- (U) Initiate development of vehicle-pilot/operator integration techniques as they relate to uninhabited combat vehicles.		
	Develop control integration technologies and simulations for uninhabited combat air vehicles.		
- (U) \$1,777	- (U) Incorporate multi-element combat environment and scenarios for an uninhabited combat air vehicle air-to-ground baseline.		
	Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.		
- (U) \$16,291	- (U) Support the development of high angle-of-attack air combat and weapon targeting technology assessment tools.		
	Total		

Project 2403

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2403	
(U) FY 1999 (\$ in Thousands):			
- (U) \$5,142	Develop and demonstrate advanced flight control techniques to provide air combat advantage by increasing performance and survivability while decreasing cost and supportability requirements.		
-	(U) Complete simulations and continue firmware development of advanced control concepts enabling reduced structural weight and cost.		
-	(U) Complete demonstration of a low-cost alternative to conventional actuators and continue advanced actuation development to increase survivability while decreasing logistical support train.		
-	(U) Continue developing control strategies that enable interactive and cooperative flights of manned and unmanned aircraft to increase mission effectiveness, attack options and all weather point-of-use delivery.		
-	(U) Complete risk reduction assessment and global operational analyses for advanced optical air data sensor development.		
-	(U) Complete evaluation of open control system infrastructure incorporating commercial processors and data busses in flight critical applications.		
- (U) \$4,677	Develop new flight control design methods and criteria that provide air combat advantage by increasing performance and survivability while decreasing cost.		
-	(U) Validate reconfigurable flight control techniques which allow battle damaged, reduced signature aircraft to fly safely.		
-	(U) Evaluate on-board techniques to detect and alleviate pilot-induced control problems.		
-	(U) Validate design standards for flight control systems that prevent pilot-induced control problems.		
-	(U) Evaluate methods for improving modeling of non-linear aerodynamics for use in design simulations.		
-	(U) Evaluate control technologies for global range transport aircraft.		
- (U) \$2,339	Develop enhanced vehicle-pilot integration technologies to improve overall weapon system performance and exploit real-time on-board/off-board data.		
-	(U) Continue development and evaluate vehicle-pilot integration technologies for in-flight mission planning and automated low-level flight.		
-	(U) Develop advanced pilot decision aids to improve tactical landing approaches and air-to-air situational awareness.		
-	(U) Continue review of operator mission requirements; evaluate availability/applicability of human-machine interface technologies.		
-	(U) Develop pilot-operator integration technologies for mission re-planning task consent, and system status information.		
-	Develop capabilities to evaluate ways to increase performance and survivability while decreasing cost and supportability requirements.		
- (U) \$3,598	(U) Perform comparison tests of combat aiding technologies through international network air combat simulation.		
-	(U) Develop evaluation techniques for the assessment of mission effectiveness for uninhabited combat air vehicles.		

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2403	
- (U) \$1,977	Develop control integration technologies and simulations for uninhabited combat aerial vehicles.		
- (U)	Continue expansion of uninhabited combat air vehicle air-to-ground simulation and establishment of a baseline.		
- (U)	Initiate integration of advances in command generation, control architecture, and flight management technologies into a flight control system for uninhabited combat air vehicles.		
- (U) \$17,733	Total		

Project 2403

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2403	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)		FY 1997	FY 1998
(U) Current Budget Submit/FY 1999 PB		19,179	17,059
		19,260	16,291
			FY 1999
			17,990
			17,733
		Total	
		Cost	
		Cont	
		Cont	
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0602202F, Human Systems Technology.			
- (U) PE 0602204F, Aerospace Avionics.			
- (U) PE 0603205F, Flight Vehicle Technology.			
- (U) PE 0603245F, Flight Vehicle Technology Integration.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602201F Aerospace Flight Dynamics

2404

COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2404 Aeromechanics and Integration	14,977	15,115	16,347	16,749	16,759	17,233	17,688	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops aerodynamic design integration technologies for current and future flight vehicles, focusing on speed regimes ranging from low to high Mach. These technologies have potential to reduce costs, improve range to yield enhanced global force projection, improve maneuverability, and reduce observability. This project integrates technologies into air vehicle concepts and develops design assessment and analysis tools.

## (U) FY 1997 (\$ in Thousands):

- (U) \$8,863 Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reduced drag, improved fuel fraction, enhanced maneuverability and control, and reduced signature.
  - (U) Completed advanced, low-cost, compact engine inlet designs to increase mission range of combat aircraft.
  - (U) Completed advanced concept development for fluid, low-cost, reduced signature, thrust-vectoring nozzles.
  - (U) Completed study of high-lift aerodynamic concepts to reduce landing take-off distances for affordable, survivable transport aircraft.
  - (U) Completed development of low-drag/low-observable aerodynamic weapons carriage concepts to increase weapons payload and air vehicle range and survivability.
  - (U) Developed concepts and design criteria for advanced, affordable, intermediate-range, manned and unmanned aircraft to provide fast reaction strike capability.
  - (U) Developed high-payoff aerodynamic concepts that significantly extend combat aircraft mission range.
  - (U) Investigated variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.
  - (U) Investigated active flow control concepts for low-observable fighter take-off/landing and maneuver performance enhancement.
  - (U) Investigated methods for reducing aeroacoustic damage in aircraft twin nozzle installations to increase nozzle service life.
- (U) \$2,946 Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.
  - (U) Completed aerodynamic design optimization code for analysis of aircraft performance and survivability.
  - (U) Initiated development of mathematical models and preliminary assessment and evaluation of aerodynamic and structural interactions in aging aircraft and advanced flight vehicles.
  - (U) Initiated numerically-based analysis capability to support weapons certification, crew escape, and safe paratrooper operation.
  - (U) Initiated development and assessment of rapid, accurate methods to predict aerodynamic performance and to evaluate advanced, affordable air vehicle designs.

Project 2404

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602201F Aerospace Flight Dynamics	2404	
- (U) \$3,168	Developed integrated concepts, design, and analysis tools for fixed wing air vehicles.		
- (U) \$14,977	- (U) Developed architecture for integrating air vehicle design methods for Air Force, Navy, NASA, and industry.		
- (U) \$14,977	- (U) Developed designs for selected baseline aircraft concepts and identified relevant technologies.		
- (U) \$14,977	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$8,990	Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reducing drag, improving fuel fraction, enhancing maneuverability and control, and reducing signature.		
- (U) \$8,990	- (U) Investigate concepts for aero-structurally integrated compact inlet designs to decrease aircraft weight, cost, and radar detection.		
- (U) \$8,990	- (U) Investigate rapid, low-cost aerodynamic assessment methods to reduce risk of weapon/aircraft integration, carriage, and separation.		
- (U) \$8,990	- (U) Develop aerodynamic configurations that significantly extend the range of unmanned combat aerial vehicles.		
- (U) \$8,990	- (U) Complete development of high-payoff aerodynamic concepts that significantly extend combat aircraft mission range.		
- (U) \$8,990	- (U) Investigate innovative vehicle/weapons aerodynamics that use emerging technologies to increase payload, survivability, and range.		
- (U) \$8,990	- (U) Develop variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.		
- (U) \$8,990	- (U) Develop active flow control concepts for low-observable fighter take-off/landing and maneuver performance enhancement		
- (U) \$8,990	- (U) Investigate advanced active flow control devices for nozzle area control, mixing, and thrust vectoring for lightweight affordable flight vehicles.		
- (U) \$3,083	- (U) Assess aerodynamic and aerothermodynamic characteristics of high-speed air vehicle concepts.		
- (U) \$3,083	Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.		
- (U) \$3,083	- (U) Initiate development of aerodynamic design optimization code for application to tailless aircraft geometry to maximize performance for multiple flight conditions, such as short field take-off and low-drag cruise.		
- (U) \$3,083	- (U) Extend development of mathematical models of aerodynamic and structural interactions in aging aircraft and advanced flight vehicles.		
- (U) \$3,083	- (U) Extend development of numerically-based analysis capability to support weapons certification, crew escape, and safe paratrooper deployment with emphasis on cavity flows.		
- (U) \$3,038	- (U) Extend development and demonstration of rapid, accurate methods to predict and evaluate aerodynamic performance of advanced, affordable air vehicle designs and accelerate development of time-dependent analysis.		
- (U) \$3,038	Develop integrated concepts, design, and analysis tools for fixed wing air vehicles.		
- (U) \$3,038	- (U) Demonstrate modular architecture for integrating air vehicle design and analysis methods for Air Force, Navy, and NASA.		
- (U) \$3,038	- (U) Complete development of "families" of baseline aircraft designs; identify common characteristics needed to facilitate trade studies.		
- (U) \$15,115	- (U) Develop and demonstrate cost estimating tool to determine return on investment for broad range of technologies.		
- (U) \$15,115	Total		

Project 2404

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Exhibit R-2 (PE 0602201F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>2 - Applied Research</b>	<b>0602201F Aerospace Flight Dynamics</b>	<b>2404</b>

  

(U) FY 1999 (\$ in Thousands):	
- (U) \$9,838	Develop and demonstrate affordable technologies to increase aerodynamic performance and survivability through reducing drag, improving fuel fraction, enhancing maneuverability and control, and reducing signature.
-	(U) Develop aero-structurally integrated components for compact inlet designs to decrease aircraft weight, cost, and radar detection.
-	(U) Investigate critical aeromechanical components for survivable, multi-purpose transport aircraft configurations.
-	(U) Develop rapid, low-cost aerodynamic assessment methods to reduce risk of weapon/aircraft integration, carriage, and separation.
-	(U) Complete development of aerodynamic configurations that significantly extend the range of unmanned combat aerial vehicles.
-	(U) Develop innovative vehicle/weapons aerodynamic concepts that use emerging technologies to increase payload, survivability, and range.
-	(U) Develop variable geometry, continuous moldline, external fuel tank concepts to extend fighter mission range.
-	(U) Develop active flow control concept development for low-observable fighter take-off/landing and enhanced maneuvering.
-	(U) Develop advanced active-flow control devices for lightweight and affordable nozzle area control, mixing, and thrust vectoring in air vehicles.
-	(U) Investigate aerodynamic characteristics of a global range strike/reconnaissance air vehicle concept.
- (U) \$3,332	Develop and demonstrate numerical technologies to derive advanced aircraft designs while increasing performance and reducing signature.
-	(U) Extend development of aerodynamic design optimization code for application to entire aircraft geometry to maximize performance for multiple flight conditions, such as short field take-off and low-drag cruise.
-	(U) Complete mathematical model development of aerodynamic and structural interactions in aging aircraft and advanced air vehicles.
-	(U) Complete development of numerically-based analysis capability to support weapons certification, crew escape, and safe paratrooper deployment and assessment of acoustic effects.
-	(U) Complete development and assessment of rapid and accurate methods to predict aerodynamic performance and to evaluate advanced affordable air vehicle designs, including multidisciplinary analyses.
-	(U) Develop numerically-based method to analyze the performance of aircraft with active flight control surfaces.
- (U) \$3,506	Develop integrated concepts, design, and analysis tools for fixed wing air vehicles.
-	(U) Complete development efforts and transition the integrated air vehicle design and analysis tool kit for Air Force, Navy, NASA, and industry air vehicle concepts to the user.
-	(U) Update designs for "families" of baseline aircraft concepts and identify relevant evolutionary technologies needed.
-	(U) Complete verification and validation of physics and technology based cost estimating tool to determine return on investment for broad range of aerodynamic technologies.
- (U) \$16,347	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>2 - Applied Research</b>	<b>0602201F Aerospace Flight Dynamics</b>	<b>2404</b>	
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		14,997	15,925
(U) Current Budget Submit/FY 1999 PB		14,977	15,115
			FY 1999
			16,676
			16,347
			Total
			Cost
			Cont
			Cont
<b>(U) Change Summary Explanation:</b>			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
- (U) PE 0603205F, Flight Vehicle Technology.			
- (U) PE 0603260F, Hypersonic Technology Development.			
- (U) PE 0603245F, Flight Vehicle Technology Integration.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
<b>(U) D. Schedule Profile:</b> Not Applicable.			

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Exhibit R-2 (PE 0602201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602201F Aerospace Flight Dynamics								4397	
			FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4397	Air Base Technology	COST (\$ In Thousands)	1,865	466	1,372	1,952	1,556	965	2,431	Continuing	Continuing
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project develops technologies for fixed and bare base operations, including airfield pavements, energy systems, automation, air base survivability, air base recovery, protective systems, fire protection, and crash rescue.</p> <p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$906 Develop design criteria, methodology, and advanced technology concepts for improved bare base and fixed site applications (e.g., power and environmental utilities, survivable air base structures, and durable or repairable airfield surfaces).</li> <li>- (U) \$150 Developed applications using lightweight, composite, deployable structures to reduce airlift and manpower requirements.</li> <li>- (U) \$809 Developed advanced real-time pavement quality control and quality assurance tools.</li> <li>- (U) \$809 Develop concepts for advanced ground power generators such as high-efficiency solar cells, solid oxide, and commercially-available conversions for reduced size, weight, and cost and increased transportability.</li> <li>- (U) \$1,865 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training subsystems).</li> <li>- (U) \$1,865 Completed study of the impact of JP-8 fuel on aircraft hangar fire protection requirements.</li> <li>- (U) \$0 Total</li> </ul> <p>(U) FY 1998 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$500 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems.)</li> <li>- (U) \$0 Develop advanced agents for three-dimensional fire fighting.</li> <li>- (U) \$0 Complete development of concepts for advanced aircraft hanger fire protection, transition to Advanced Technology Development.</li> <li>- (U) \$0 Complete development of electromagnetic pulse fire suppression</li> <li>- (U) \$0 Develop technologies (i.e., utilities and shelters) that improve air mobility systems performance and reduce airlift requirements in support of Air Expeditionary Force (AEF) operations.</li> <li>- (U) \$0 Complete conceptual design for a logistics fuel for use in fuel cells.</li> <li>- (U) \$466 Develop air transportable shelters that are lightweight and can be assembled quickly for AEF applications</li> <li>- (U) \$0 Total</li> </ul>											

Project 4397

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602201F Aerospace Flight Dynamics</b>	PROJECT <b>4397</b>
(U) FY 1999 (\$ in Thousands):		
- (U) \$692	Develop aircraft and air base fire fighting technologies (e.g., clean environmentally safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment technologies, and fire fighting training systems).	
	- (U) Continue development of advanced agent for three-dimensional fire fighting.	
	- (U) Develop new technologies to improve fire fighting rescue capability (Infrared imaging, data acquisition, and personnel accountability system).	
	- (U) Develop all-weather, unimproved terrain, and autonomous fire fighting capability.	
- (U) \$682	Develop technologies (i.e., utilities and shelters) that improve air mobility systems performance and reduce airlift requirements in support of Air Expeditionary Force (AEF) operations.	
	- (U) Continue development of air transportable shelters.	
	- (U) Develop a deployable waste management system in support of AEF operations.	
	- (U) Develop new rapidly installed lightweight matting from composite materials to replace the existing AM-2 matting.	
- (U) \$1,372	Total	

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602201F Aerospace Flight Dynamics

4397

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	1,868	500	1,494	Cost
(U) Current Budget Submit/FY 1999 PB	1,865	466	1,372	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603307F, Air Base Operability Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
2 - Applied Research		0602202F Armstrong Lab Exploratory Development									
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
Total Program Element (PE) Cost	86,404	72,118	60,805	55,802	57,661	54,197	53,419	Continuing	Continuing		
1123 Manpower, Personnel, and Training	20,139	18,846	14,534	12,275	13,660	12,392	12,754	Continuing	Continuing		
1710 Logistics Technology	5,875	5,060	3,365	3,057	3,194	3,236	3,360	Continuing	Continuing		
1900 Environmental Quality Technology	9,651	4,248	3,807	3,045	1,097	1,756	0	0	Continuing		
7184 Crew Technology	30,337	25,435	26,395	27,625	28,029	25,837	27,104	Continuing	Continuing		
7755 Aircrew Physiology Technology	6,481	4,496	0	0	0	0	0	0	Continuing		
7757 Toxicology/Radiation/Noise Hazards	13,921	14,033	12,704	9,800	11,681	10,976	10,201	Continuing	Continuing		
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		
<b>(U) A. Mission Description and Budget Item Justification:</b> This Applied Research program establishes technology feasibility and develops the technology base for Air Force human interface needs required for weapon systems, operational readiness, and environmental quality. The program addresses crew systems; manpower, personnel, training, and logistics; aerospace physiology investigation; occupational and environmental safety; and environmental compliance and site remediation. Crew systems technologies increase the performance of humans in weapon systems operation by improving aircrew life support systems, man-machine integration (to include aircraft information display systems), and protection from biodynamic forces (ejection/escape). Manpower, personnel, training, and logistics technologies focus on reducing manpower required to operate and support weapon systems by: providing more effective methods to classify, train, and retain warfighters and their support force; modeling human cognitive functioning on complex tasks to enhance operational performance; increasing weapon systems supportability; and improving wartime logistics planning. Occupational and environmental health and safety technologies support deployment, operation, and maintenance of Air Force weapon systems by developing: occupational and operational exposure safety guidelines for militarily relevant electromagnetic radiations and toxicants; detection, control, reduction, and disposal of pollutants from Air Force operations; and cleaning up contaminated Air Force sites. Payoff from these technology development efforts is to improve combat effectiveness by expanding all parameters defining operational performance limits. Note: Congressional add of \$2 million in FY 1997 for Helmet-Mounted Display technologies (Project 7184) explains part of the decrease from FY 1997 to FY 1998. The remaining decrease in FY 1999 is due to elimination of Aircrew Physiology Technology (Project 7755).											

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Exhibit R-2 (PE 0602202F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602202F Armstrong Lab Exploratory  
Development(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	86,382	76,102	77,002	Cost
(U) Appropriated Value	89,103	76,102		Cont
(U) Adjustments to Appropriated Value				
a. Congressional/General Reduction	-1,891	-2,641		
b. SBIR	-719	-1,343		
c. Omnibus/Other Above Threshold Reprogrammings	4			
d. Below Threshold Reprogrammings	-93			
e. Rescissions				
(U) Adjustments to Budget Year Since FY 1998 PB			-16,197	
(U) Current Budget Submit/FY 1999 PB	86,404	72,118	60,805	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602202F Armstrong Lab Exploratory  
Development

PROJECT

1123

COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1123 Manpower, Personnel, and Training	20,139	18,846	14,534	12,275	13,660	12,392	12,754	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project develops and evaluates new methods and technologies in support of Air Force training and education requirements in a variety of specific areas, including: aircrew training; technical training; medical reserve training; logistics training; training in support of complex decision making; space training; information warfare training; and warfare readiness training. It investigates the spectrum of new and advanced training and education technologies for optimal ways to determine needs and deficiencies, design and implement training, and to evaluate training effectiveness. It develops and evaluates specific training systems, desktop tutors, courseware development tools and technologies, assessment methodologies, and simulation-based systems to determine how to achieve maximum learning effectiveness for specific needs at minimum cost. This project will contribute to a more highly trained and flexible cadre of personnel and reduce the cost of maintaining crew, aircraft, and support personnel readiness. This Applied Research program develops technologies to increase operational readiness by providing more effective methods and approaches to classify, assign, train, assess, and retain personnel. This program focuses on reducing the manpower required to operate and support weapon systems and on improving the effectiveness of the operators, maintainers, and other support personnel for those systems.

(U) FY 1997 (\$ in Thousands):

- (U) \$ 3,547

Developed intelligent/adaptive training and instructional design technologies.

- (U) Field demonstrated the effectiveness of instructional strategies for automated, intelligent instruction in operational tasks and settings.
- (U) Demonstrated effectiveness of automatically generated instructional questions and courseware for Air Force Reserve training.
- (U) Completed evaluation of a tool for providing intelligent performance support to novice instructional designers.
- (U) Continued to develop and evaluate interactive, multimedia distance learning technologies.
- (U) Completed development of adaptive tutor for Undergraduate Navigator Training.
- (U) Continued large-scale evaluation of commercially licensed intelligent tutoring systems for fundamental math, English, and science literacy skills.
- (U) Completed development and evaluation of desktop training technology for logistics command and control.
- (U) Developed training specifications for crypto linguists.
- (U) Produced training recommendations for weather forecasting.
- (U) Developed adaptive training assessment technologies.
- (U) Developed and validated criteria to assess the effectiveness and efficiency of intelligent training technologies in operational settings.
- (U) Conducted preliminary validation of an integrated education and training assessment framework.
- (U) Transitioned automated tool for determining Air Force training requirements.
- (U) Developed individual and team measures of training effectiveness, retention, and decay.
- (U) Developed specifications for SynTeam synthetic task environment.

Project 1123

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	1123	
- (U) \$ 8,949	Developed concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.		
	- (U) Developed advanced visualization tools for classroom instruction of basic fighter maneuvers.		
	- (U) Developed metrics of team-oriented situational awareness.		
	- (U) Developed joint-Service team training guidelines for Special Operations Forces aircrew.		
	- (U) Evaluated virtual debrief system for basic fighter maneuver training.		
	- (U) Assessed training value of variable time simulator training on acquisition of combat tasks.		
- (U) \$ 1,566	- (U) Developed training techniques for Blue Flag Battlestaff exercises.		
	Developed guidelines for fidelity specifications for visual technologies used to improve aircrew training simulators.		
	- (U) Determined training value of eye-position monitoring as visual feedback tool for combat mission training.		
	- (U) Determined effect of field of view of helmet-mounted displays on eye-head movements during a search task.		
- (U) \$ 2,175	- (U) Developed model of color perception for mesopic (night time) luminance displays.		
	Developed and transitioned technologies to select and classify Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.		
	- (U) Determined the relationship of individual aptitude and experience to training time and equipment repair time.		
	- (U) Developed personnel decision support system - Personnel Management Information and Support System (PERMISS) module for Permanent Change of Station (PCS) entitlements.		
- (U) \$ 3,147	Developed technologies to improve assessment of abilities of Air Force personnel.		
	- (U) Developed adaptive and generative tests of abilities to improve precision while decreasing test administration time.		
	- (U) Continued development of data base of specific mental capabilities required for complex, high-technology jobs.		
	- (U) Continued to develop techniques to conduct on-the-job performance assessment.		
	- (U) Completed techniques to measure personality and motivation.		
	- (U) Continued to collect test data to evaluate minority group performance on aircrew selection tests.		
	- (U) Validated crew resource management skills test for selection of C-130 pilots.		
	- (U) Identified ability demands of Joint Primary Aircraft Trainer (JPAT) and Specialized Undergraduate Pilot Training (SUPT).		
	- (U) Developed test battery for Uninhabited Combat Air Vehicle controller selection.		
	- (U) Developed screening systems for selecting weapons directors, navigators, and air traffic controllers.		
	- (U) Developed Uninhabited Air Vehicle (UAV) operator screening assessment tool.		
	- (U) Developed risk-taking assessment device.		
- (U) \$20,139	Total		

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# RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602202F Armstrong Lab Exploratory  
Development

PROJECT

1123

(U) FY 1998 (\$ in Thousands):

- (U) \$ 2,791 Continue development of intelligent/adaptive training and instructional design technologies.
- (U) Continue demonstration of the effectiveness of instructional strategies for automated, intelligent instruction in operational Air Force tasks and settings.
- (U) Continue to develop and evaluate interactive, multimedia distance learning technologies.
- (U) Continue development of assessment and evaluation technologies for adaptive training.
- (U) Demonstrate preliminary individual and team retention training and transfer methods.
- (U) Develop method for linking individual and team training performance effectiveness to readiness and warfighting capability.
- (U) Develop methods for identifying contingency and sustainment training requirements.
- (U) Demonstrate automated field performance assessment methods in operational contexts.
- (U) Develop adaptive information technologies to support contingency operations.
- (U) Develop methods for assessing and integrating tactical information for decision making in high information threat environments.
- (U) Develop and test intelligent search engine technologies for information gathering.
- (U) Continue development of concepts, trainers/simulators, and associated technologies to improve Air Force aircrew training.
- (U) \$ 9,840
- (U) Conduct simulation-based mission preparation and rehearsal effectiveness assessments.
- (U) Determine effects of display disparities on perception of slant and motion.
- (U) Develop surface threat visualization trainer.
- (U) Demonstrate electronic classroom technology for Specialized Undergraduate Pilot Training (SUPT).
- (U) Develop guidelines for information management in a fighter squadron environment.
- (U) Use eye tracking technology to assess the impact of alternative training strategies on visual workload for combat mission training.
- (U) \$ 1,711 (U) Continue development of technologies to improve assessment of abilities of Air Force personnel.
- (U) Continue development of database of specific mental abilities required for complex, high technology jobs (Advanced Personnel Test validation).
- (U) Continue development of adaptive and generative tests of abilities to improve precision while decreasing test administration time.
- (U) Develop and evaluate alternative concepts for measuring ability to perform complex jobs (e.g., Uninhabited Air Vehicle ground controllers under realistic stresses.)
- (U) \$ 2,522 Continue to develop and transition technologies to select and classify Air Force personnel and structure DoD jobs to maximize performance and mission accomplishment.
- (U) Determine entry and career progression job classification standards based on a life cycle approach to job eligibility.
- (U) Complete cost/benefit analysis of selected recruiting strategies to meet future demographic trends.
- (U) Field test an automated technology to collect individual and organizational productivity data.

Project 1123

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	1123	
- (U) \$ 1,352	- (U) Deliver crew resource management test to Air National Guard and United States Air Force Reserve. Develop knowledge representation technologies for human performance enhancement.		
- (U) \$ 18,846	- (U) Develop generalizable knowledge representation scheme and student modeling module.		
	- (U) Begin development of knowledge-based intelligent computer adaptive instruction authoring system.		
	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$ 3,100	Develop innovative concepts and methods to improve Air Force aircrew training.		
	- (U) Develop guidelines for Special Operations Forces simulation-based mission preparation and rehearsal strategies.		
	- (U) Develop techniques for improved battlestaff training.		
- (U) \$ 3,300	- (U) Develop instructional scenarios and syllabi for use in multi-participant distributed mission training applications. Develop model for the squadron of the future technology, Squadron XXI.		
	- (U) Define the requirements for users at all levels of squadron scheduling (e.g., mission, maintenance, weather, planning).		
	- (U) Define the information management architecture for Squadron XXI.		
- (U) \$ 6,534	- (U) Evaluate advance tools for information management in the squadron environment.		
	Determine visual perceptual requirements for out the window simulator displays.		
	- (U) Determine performance impacts of size constancy difference produced by simulator displays projected at the actual distances versus at optical infinity.		
	- (U) Assess visual display alternatives for multi-place cockpit simulators.		
- (U) \$ 1,600	Develop knowledge representation technologies for human performance enhancement.		
	- (U) Initiate development of knowledge-based technologies for curriculum planning and media selection.		
- (U) \$ 14,534	- (U) Continue development of knowledge-based intelligent computer adaptive instruction authoring system.		
	Total		

Project 1123

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Exhibit R-2 (PE 0602202F)

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602202F Armstrong Lab Exploratory  
Development

1123

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	20,211	19,822	20,422	Cost
(U) Current Budget Submit/FY 1999 PB	20,139	18,846	14,534	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602233N, Mission Support Technology: Personnel, Training, and Simulation Technology Area.
- (U) PE 0602716A, Human Factors Engineering Technology Development.
- (U) PE 0602727A, Non-System Training Devices Technology.
- (U) PE 0602785A, Manpower, Personnel, and Training Technology.
- (U) PE 0603106F, Logistics Systems Technology.
- (U) PE 0603227F, Personnel, Training, and Simulation Technology.
- (U) PE 0604227F, Flight Simulator Development.
- (U) PE 0604243F, Manpower, Personnel, and Training Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602202F Armstrong Lab Exploratory Development								1710	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
1710	Logistics Technology	5,875	5,060	3,365	3,057	3,194	3,236	3,360	Continuing	Continuing	
<p>(U) <u>A. Mission Description and Budget Item Justification:</u> This project develops technologies to: improve logistics support for both combat and peacetime operations; enhance logistics planning and assessment models for realistic wartime and contingency operations; improve logistics support requirements trade off and design methods to reduce manpower and equipment needed to support logistics operations in dispersed locations; and develop software tools for use in designing improved reliability, maintainability, supportability, and man-machine interfaces to reduce life cycle costs and increase system affordability of aging aircraft and new weapon systems.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$1,410 Continued development of technology for improved contingency logistics planning, deployment, support equipment functional upgrades.</li> <li>- (U) \$1,058 Developed computer-based design tools to minimize weapon systems deployment footprint and increase supportability.</li> <li>- (U) \$3,407 Evaluated alternatives for visual display and assessment of complex logistics control and planning data.</li> <li>- (U) \$5,875 Completed preliminary software tools to support wing-level contingency logistics planning, replanning, and support. Researched and identified user-driven reliability, maintainability, and functional requirements to improve the deployability and operational capability of aircraft ground support equipment.</li> </ul> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$1,620 Develop and compare technologies to support more flexible and less costly deployment and maintenance of airlift and combat aircraft.</li> <li>- (U) \$ 505 Research text and graphic displays, synthesis, and presentation methods to improve human comprehension of complex resource allocation tasks, enhancing wing readiness, distributed logistics mission training, logistics planning, deployment, and combat capability. Continue development of portable "wearable" logistics visualization devices and logistics information integration, command and control systems.</li> <li>- (U) \$2,935 Develop advanced visualization, option generation, and logistics command and control tools for deployment planning and execution</li> <li>- (U) \$5,060 Develop software tools and architectures that add high levels of intelligence to logistics information system interfaces and databases, for more effective use in rapid-response contingency and deployed operations.</li> </ul>											

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE

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BUDGET ACTIVITY

**2 - Applied Research**

PE NUMBER AND TITLE

**0602202F Armstrong Lab Exploratory  
Development**

PROJECT

**1710**

(U) FY 1999 (\$ in Thousands):

- (U) \$2,421	Continue development of technologies to reduce the cost and improve the performance of aircraft maintenance and increase flexibility/reduce costs of sustainment, deployment, and operations.
- (U) \$ 472	(U) Develop and evaluate technologies for use in logistics command and control environments of the future.
- (U) \$ 472	Evaluate and compare presentation technologies for improving supportability assessment and logistics command and control.
- (U) \$ 472	(U) Conduct initial in-house demonstrations and preliminary user assessments of correlated cueing techniques for assessing logistics deployment readiness.
- (U) \$ 472	Define and evaluate advanced knowledge representation schemes and computational linguistics methods to automatically extract maintenance manual information directly from for weapon systems design data.
- (U) \$3,365	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
2 - Applied Research		1710	
PE NUMBER AND TITLE		0602202F Armstrong Lab Exploratory Development	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	5,882	5,308	5,539
	5,875	5,060	3,365
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0602233N, Mission Support Technology: Personnel, Training, and Simulation Technology Area.			
- (U) PE 0602716A, Human Factors Engineering Technology Development.			
- (U) PE 0603106F, Logistics Systems Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602202F Armstrong Lab Exploratory  
Development

1900

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1900 Environmental Quality Technology	9,651	4,248	3,807	3,045	1,097	1,756	0	0	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops technologies to characterize the chemistry of Air Force-generated pollutants and toxic materials, assesses their interaction with the environment, and develops reduction/destruction and control techniques. Efforts are conducted to reduce the cost and increase the effectiveness of technologies that protect the environment. New Air Force fuels and chemicals are analyzed to identify and prevent possible environmental problems. Materials are investigated and new processes explored to assess and reduce environmental risks. Novel monitoring and modeling technologies are also explored.

(U) FY 1997 (\$ in Thousands):

- (U) \$2,642 Developed technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.
- (U) Characterized the fate and transport characteristics of Dense Nonaqueous Phase Liquids (DNAPLs) in soils and groundwater using physical model studies to validate and develop models to determine the best effects of physical, chemical, and biological processes to degrade contaminants.
- (U) Identified and resolved environmental and operational safety issues for Large-Scale Chemical Laser (LSCL) systems.
- (U) Determined the atmospheric chemistry of candidate and new Air Force fuels and chemicals; developed a database of the rates of photochemical and dark reactions of Air Force organic solvent vapors, new fire extinguishants, and new fuels in the presence of specific air pollutants.
- (U) \$4,009 Developed technologies to reduce wastes and contamination of the environment caused by Air Force materials and operations.
- (U) Investigated, selected, and tested several novel technologies to remove emulsified oil and suspended particulates from oil-water separator effluents and aqueous cleaning/degreasing tanks.
- (U) Developed affordable technologies to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments; developed pulsed corona reactor technology for jet engine test cells.
- (U) \$3,000 Developed technologies to destroy wastes and contamination of the environment caused by Air Force materials and operations.
- (U) Developed innovative technologies to treat/recycle metal/halogen contaminated sludge and other hazardous wastes from Air Force industrial operations to reduce disposal/recycle costs and comply with regulatory standards.
- (U) Developed chemical reactors to convert liquid wastes and energetic materials to non-hazardous products and to treat other complex chemical waste effluents.
- (U) \$9,651 Total

Project 1900

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Exhibit R-2 (PE 0602202F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>2 - Applied Research</b>		<b>0602202F Armstrong Lab Exploratory Development</b>	<b>1900</b>
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 885	Develop technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.		
- (U)	Continue to determine the atmospheric chemistry of candidate and new Air Force fuels and chemicals; develop a database of the rates of photochemical and dark reactions of Air Force solvent vapors, new fire extinguishants, and new fuels in the presence of specific air pollutants.		
- (U)	Continue to identify and resolve the environmental and operational safety issues for Large-Scale Chemical Laser (LSCL) systems.		
- (U)	Complete natural attenuation study to prove that natural biodegradation of hydrocarbon contaminants is an acceptable method of treatment.		
- (U) \$1,814	Develop space launch risk assessment model to assess the fate and transport of toxic emissions in catastrophic aborts.		
- (U)	Develop technologies to reduce wastes and contamination of the environment by Air Force materials and operations.		
- (U)	Develop affordable technology to control air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments.		
- (U) \$1,549	Develop technologies to destroy wastes and contamination of the environment by Air Force materials and operations.		
- (U)	Develop chemical reactors to convert liquid wastes and energetic materials to non-hazardous products and to treat other complex chemical wastes.		
- (U) \$4,248	Total		

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE

February 1998

BUDGET ACTIVITY

**2 - Applied Research**

PE NUMBER AND TITLE

**0602202F Armstrong Lab Exploratory  
Development**

PROJECT

**1900**

(U) FY 1999 (\$ in Thousands):

- (U) \$1,428 Develop technologies and design criteria for improved monitoring, characterization, and assessment of risks to the environment posed by Air Force activities.
- (U) Continue to determine the atmospheric chemistry of candidate and new Air Force fuels and chemicals; develop an experimental database for gas-phase reactions of new Air Force industrial solvents, fire extinguishing agents, and halons in the presence of targeted air pollutants.
- (U) \$ 500 Develop technologies to reduce wastes and contamination of the environment by Air Force materials and operations.
- (U) Develop affordable technology for control of air polluting emissions from Air Force industrial processes to comply with Clean Air Act Amendments.
- (U) \$1,879 Develop technologies to destroy wastes and contamination of the environment by Air Force materials and operations.
- (U) Develop chemical reactors to convert liquid wastes and energetic materials to non-hazardous products and to treat other complex chemical wastes.
- (U) Develop and identify novel strategies for biosynthesis and biodegradation of DoD materials and chemicals.
- (U) \$3,807 Total

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	1900	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	9,661	4,534	5,827
	9,651	4,248	3,807
			Total
			Cost
			Cont
			0
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0601102F, Defense Research Sciences.			
- (U) PE 0602102F, Materials.			
- (U) PE 0602203F, Aerospace Propulsion.			
- (U) PE 0603211F, Aerospace Structures.			
- (U) PE 0603723F, Environmental Engineering Technology.			
- (U) PE 0603716D, Strategic Environmental Research and Development Program.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602202F Armstrong Lab Exploratory  
Development

PROJECT

7184

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7184 Crew Technology	30,337	25,435	26,395	27,625	28,029	25,837	27,104	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops the technology required to improve human performance, protection, and survivability in operational environments. This is accomplished by defining the physical parameters, capabilities, and limits of systems operators; determining human responses to operational stresses such as noise, impact, vibration, hostile fire, sustained acceleration, spatial disorientation, altitude, workload, and sustained operations; and optimizing the human-machine interface. The project produces human factors design criteria, guidelines, and automated design tools for the development of effective technologies for information display, team communications, crew scheduling and fatigue management, control interfaces, emergency escape, crash protection, acceleration protection, and aircrew life support.

(U) FY 1997 (\$ in Thousands):

- (U) \$ 2,002 Developed unobtrusive, reliable predictors of human systems effectiveness.
- (U) Developed an analytical description of crew performance in Theater Missile Defense attack operations simulation.
- (U) Integrated memory probes, attention allocation, and other mental components for inclusion into an overall situation awareness conceptual model.
- (U) \$ 5,545 Developed system design technologies for greater integration of human performance data and improved collaborative system interfaces.
- (U) Completed software to collect and reduce data for whole body, three-dimensional anthropometric scanning system.
- (U) Demonstrated analytical methodology for cognitive engineering in support of information dominance.
- (U) \$ 7,857 Developed visual displays and symbology technology for improved human-machine interfaces and demonstrated virtual cockpit technology.
- (U) Evaluated wide field-of-view, ejection-safe night vision goggle technology.
- (U) Demonstrated integrated virtual cockpit technology for improved air-to-air engagement performance.
- (U) Prototyped ruggedized miniature-image display electronics and helmet-vehicle interface (HVI) analyzer for flight demonstration.
- (U) Developed binocular helmet-mounted sight/display (HMS/D) specifications and test standards.
- (U) \$ 4,349 Developed injury criteria and technology for improved aircrew and support personnel protection equipment.
- (U) Evaluated accommodation criteria for through-the-canopy impact and extremity clearance for aircraft training systems.
- (U) Developed combined crew member/ejection seat model.
- (U) Compared multimedia work technologies for use by engineers to evaluate concepts for aircrew protection.
- (U) Developed neck injury probability assessment methodology using experimental and operational data.
- (U) \$ 2,900 Developed technologies to measure and predict the effects of human auditory responses and to provide criteria for voice communication for selected Air Force weapon systems and base operations.

Project 7184

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	7184	
	<ul style="list-style-type: none"><li>- (U) Developed, demonstrated, and transitioned audio performance measurement technologies for assessment of individual auditory localization ability in operational situations.</li><li>- (U) Developed advanced models, criteria, and technologies for improving human audio communication for Air Force weapon systems and for degrading communications capabilities of opposing forces.</li></ul>		
- (U) \$ 3,056	Developed technologies for evaluating and improving personal protection and effectiveness of aircrew and support personnel operating in hazardous environments.		
	<ul style="list-style-type: none"><li>- (U) Developed and evaluated technologies to protect aircrew and enhance performance in the high-G environment.</li><li>- (U) Defined risk and demonstrated countermeasures to high altitude physiology risk in reconnaissance operations.</li></ul>		
- (U) \$ 4,628	Developed technologies for sustained aircrew operations and integration of life support technologies into aircraft to improve aircrew safety and performance.		
	<ul style="list-style-type: none"><li>- (U) Demonstrated fitness-for-duty performance metrics and team decision making strategies for enhanced performance in long-duration missions.</li><li>- (U) Initiated research on ceramic oxygen generation technology for aircraft and field hospital applications.</li><li>- (U) Developed and transitioned advanced spatial disorientation technologies and countermeasures for aircrew.</li></ul>		
- (U) \$30,337	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 1,787	Continue to develop unobtrusive, reliable predictors of human systems effectiveness.		
	<ul style="list-style-type: none"><li>- (U) Develop a computer-based model of workload and situation awareness for crew performance in Theater Missile Defense attack operations mission.</li><li>- (U) Develop an overall situation awareness model by including integration of memory probes, attention allocation, and other mental components.</li><li>- (U) Integrate psychophysical and performance metrics into an on-line workload classifier.</li></ul>		
- (U) \$ 4,654	Continue to develop system design technologies for improved integration of human performance data and collaborative system interfaces.		
	<ul style="list-style-type: none"><li>- (U) Complete first whole-body, three-dimensional anthropometric survey.</li><li>- (U) Complete prototype of expert computer-aided design (CAD) program incorporating crew station design guidelines.</li><li>- (U) Demonstrate DoD-common surveillance automatic target recognizer workstation integration.</li></ul>		
- (U) \$ 6,531	Continue to develop visual displays and symbology technology for improved human-machine interfaces and demonstrate sensor-augmented cockpit technology for spaceplane or synthetic vision applications.		
	<ul style="list-style-type: none"><li>- (U) Develop baseline performance need for next generation sighting system.</li><li>- (U) Develop flat cathode ray tube and hybrid optics for advanced helmet-mounted sight/display.</li><li>- (U) Develop visual requirements for on-board sensor processing.</li></ul>		

Project 7184

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	7184	
- (U) \$ 3,205	<ul style="list-style-type: none"> <li>- (U) Demonstrate multi-sensory, virtual air-to-air and air-to-ground cockpit design principles.</li> <li>- (U) Develop ejection-safe, panoramic night vision goggle with integrated display.</li> <li>- (U) Develop standardized test methods for night vision devices and transparencies.</li> </ul> <p>Continue to develop injury criteria and technology for improved aircrew and support personnel protection equipment.</p> <ul style="list-style-type: none"> <li>- (U) Formulate modeling technology to assess combined coupling aerodynamic and inertial forces on the head and neck during high-speed escape.</li> <li>- (U) Validate performance of integrated ejection seat and human dynamics models.</li> <li>- (U) Develop hardware and software specifications for a suite of simulation tools for human modeling in dynamic environments.</li> <li>- (U) Complete Head-Spine Model (Personal Computer Version).</li> </ul>		
- (U) \$ 2,900	<p>Continue to develop improved aural technologies for enhanced human-system interface, develop technologies to measure and predict the effects of human auditory responses, and provide voice communication criteria for selected Air Force weapon systems and base operations.</p> <ul style="list-style-type: none"> <li>- (U) Develop, demonstrate, and integrate three-dimensional audio technology applications for air- and ground-based command, control, and communications.</li> <li>- (U) Continue integration of auditory and visual display technologies and symbologies for air-to-air, air-to-ground, and ground applications.</li> <li>- (U) Develop and demonstrate auditory localization screening test methodology and hardware for improved personnel performance/safety.</li> <li>- (U) Continue development of advanced models, criteria, and technologies for improving human audio communication for Air Force weapon systems and for degrading communications capabilities of opposing forces.</li> <li>- (U) Develop smaller and more economical advanced spatial audio system technologies.</li> </ul> <p>Continue to develop technologies for evaluating and improving aircrew protection and effectiveness in operational environments.</p> <ul style="list-style-type: none"> <li>- (U) Determine the effect of multi-axis accelerations on aircrew piloting performance.</li> <li>- (U) Develop physical conditioning dietary regimens to enhance G-tolerance and reduce fatigue for aircrews.</li> <li>- (U) Continue development of life support and high altitude protection technologies.</li> </ul> <p>Continue to develop technologies for sustained aircrew operations and integration of life support technologies into aircraft to improve aircrew safety and performance.</p> <ul style="list-style-type: none"> <li>- (U) Develop and demonstrate fatigue models and incorporate into campaign-level models for aircrew sustained operations.</li> <li>- (U) Develop in-flight spatial disorientation (SD) training technologies for non-mishap SD information and mishap consultation data.</li> <li>- (U) Continue research on ceramic oxygen generation technology for aircraft and field hospital applications.</li> <li>- (U) Determine psychophysiological constraints of helmet-mounted display/symbolology.</li> </ul>		
- (U) \$ 25,435	Total		

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	7184	
(U) FY 1999 (\$ in Thousands):			
- (U) \$ 2,160	Continue to develop unobtrusive, reliable predictors of human system effectiveness.		
	- (U) Apply computer model of workload and situation awareness to design evaluation of controls and displays for Theater Missile Defense attack operations mission.		
	- (U) Complete development of a single crewman situation awareness model.		
	- (U) Refine and evaluate on-line workload classifier for inclusion in a real-time operator workload evaluator.		
- (U) \$ 5,973	Continue to develop system design technologies for greater integration of human performance data and improved collaborative systems interfaces.		
	- (U) Develop a fully integrated, on-line data system to serve as an international resource for human anthropometric data and applications software.		
	- (U) Develop a computer-aided design (CAD) tool that accurately represents the human body as a software template in the interactive CAD environment.		
	- (U) Demonstrate models and metrics for distributive situational awareness and adaptive decision-making.		
	- (U) Demonstrate human-aiding network software to streamline the sharing, synchronization, and analysis of operational mission data among intelligence analyst and command centers.		
- (U) \$ 8,037	Continue to develop visual displays and symbology technology for improved human-machine interfaces and demonstrate adaptive interface technology.		
	- (U) Develop integrated display and information processing standards for targeting helmet-mounted sight/display.		
	- (U) Develop design alternatives for lightweight integrated helmet-mounted display and sighting system using eye line-of-sight.		
	- (U) Develop ejection-safe, panoramic night vision goggle with integrated external sensor input for night operations.		
	- (U) Demonstrate a pilot-vehicle interface whose functionality changes with pilot physiologic and behavioral states driven by the combat situation.		
- (U) \$ 3,889	Continue to develop injury criteria and technology for improved aircrew and support personnel protective equipment.		
	- (U) Validate airbag/occupant model versus impact test data for potential application to air vehicles.		
	- (U) Develop, as part of the Biodynamic Work Environment, a common Biodynamic Data Bank Format and User Interface for DoD, the National Highway Transportation Safety Administration, and the Federal Aviation Administration.		
	- (U) Develop stability criteria for helmet-mounted displays in a vibration or multiple impact environment.		
- (U) \$ 3,801	Continue expansion of advanced aural technologies for enhanced human systems interfaces; establish new principles and methodologies of information management for exploitation of information warfare applications.		
	- (U) Evaluate and apply three-dimensional audio technologies for operator intensive applications in special uninhabited air vehicle and command, control, and communications functions using smaller, cost-effective auditory/visual displays and customized symbology.		

Project 7184

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	06022202F Armstrong Lab Exploratory Development	7184	
<ul style="list-style-type: none"><li>- (U) Advance methodologies and technologies for quantifying individual auditory localization ability of operational personnel in combat and occupational positions.</li><li>- (U) Develop and demonstrate novel voice modification and intelligent jammer technologies for enhanced information warfare operations. Continue to develop distributed mission training technologies that enhance aerial combat performance during sustained operations.</li><li>- (U) Improve integrated mission rehearsal training technologies for aircrew and battle staff in simulated and field sustained operations. Support the joint Air Force/Defense Advanced Research Projects Agency Unmanned Combat Air Vehicle (UCAV) program.</li><li>- Total</li></ul>			

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Exhibit R-2 (PE 0602202F)

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
2 - Applied Research	0602202F Armstrong Lab Exploratory Development	7184																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="0"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>30,204</td> <td>26,970</td> <td>26,181</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>30,337</td> <td>25,435</td> <td>26,395</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&amp;T) Program.            Schedule: Not Applicable.            Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0602702F, Command, Control, and Communications.</li> <li>- (U) PE 0603205F, Aerospace Vehicle Technology.</li> <li>- (U) PE 0603227F, Advanced Simulator Technology.</li> <li>- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> <li>- (U) PE 0603245F, Flight Vehicle Technology Integration.</li> <li>- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.</li> <li>- (U) PE 0604706F, Life Support Systems.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	30,204	26,970	26,181	Cost	(U) Current Budget Submit/FY 1999 PB	30,337	25,435	26,395	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	30,204	26,970	26,181	Cost														
(U) Current Budget Submit/FY 1999 PB	30,337	25,435	26,395	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602202F Armstrong Lab Exploratory  
Development

7755

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7755 Aircrew Physiology Technology	6,481	4,496	0	0	0	0	0	0	Continuing

(U) A. Mission Description and Budget Item Justification: The human operator is the enabling factor in aerospace systems. The goal of this project is to optimize aircrew effectiveness by developing an understanding of: (1) conditions affecting aircrew selection and retention; (2) methods of early disease detection; (3) impact of asymptomatic disease on aircrew performance; (4) therapeutic drug effects on flight safety; and (5) physiological factors affecting operational readiness and effectiveness.

(U) FY 1997 (\$ in Thousands):

- (U) \$3,702 Developed technologies for improving aircrew standards.
- (U) Continued to refine standards (i.e., cardiovascular, vision/optical devices, neuropsychiatric, and hearing/vestibular standards) to improve aircrew selection, retention, and performance.
- (U) Developed medical informational technology to assess impact of asymptomatic disease on aircrew operational performance.
- (U) Developed and validated operational cockpit glare testing technology.
- (U) Assessed physiological factors affecting female aircrew (i.e., ob-gyn, orthopedic, G-tolerance) performance.
- (U) Developed template for therapeutic modalities to reduce number of grounded aviators and to enhance performance in the aviation environment.
- (U) \$1,379 Developed operational performance enhancement technologies.
- (U) Compared advanced operational vision performance technologies (e.g., refractive surgery for aircrew use).
- (U) Developed methods to identify and remediate physiological impairments arising from flying high performance aircraft.
- (U) \$1,400 Developed technologies to improve quality and efficiency of aircrew operational evaluations.
- (U) \$6,481 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$4,116 Developed operational performance enhancement technologies.
- (U) Develop and evaluate aircrew vision enhancement technologies for both day and night air combat.
- (U) Develop methods to identify and remediate physiological impairments arising from flying high performance aircraft.
- (U) \$ 265 Conduct and complete expanded physical fitness test battery.
- (U) \$ 115 Conduct and complete fire fighter physical fitness program.
- (U) \$4,496 Total

Project 7755

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998																				
BUDGET ACTIVITY	PROJECT 7755																						
2 - Applied Research	0602202F Armstrong Lab Exploratory Development																						
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>(U) FY 1999: Not Applicable.</p> <p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 10%; text-align: center;">FY 1997</th> <th style="width: 10%; text-align: center;">FY 1998</th> <th style="width: 10%; text-align: center;">FY 1999</th> <th style="width: 10%; text-align: center;">Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td style="text-align: center;">6,488</td> <td style="text-align: center;">4,717</td> <td style="text-align: center;">4,590</td> <td style="text-align: center;"><u>Cost</u></td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td style="text-align: center;">6,481</td> <td style="text-align: center;">4,496</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Cont</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td style="text-align: center;">0</td> </tr> </tbody> </table> </div> <div style="width: 50%;"> <p>(U) Change Summary Explanation:  Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program. In FY 1999, this project has been eliminated.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> </div> </div>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	6,488	4,717	4,590	<u>Cost</u>	(U) Current Budget Submit/FY 1999 PB	6,481	4,496	0	Cont					0
	FY 1997	FY 1998	FY 1999	Total																			
(U) Previous President's Budget (FY 1998 PB)	6,488	4,717	4,590	<u>Cost</u>																			
(U) Current Budget Submit/FY 1999 PB	6,481	4,496	0	Cont																			
				0																			
<p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> <li>- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.</li> <li>- (U) PE 0604706F, Life Support Systems.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>																							

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602202F Armstrong Lab Exploratory  
Development

PROJECT

7757

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7757 Toxicology/Radiation/Noise Hazards	13,921	14,033	12,704	9,800	11,681	10,976	10,201	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project enables the safe operational use of Air Force weapon systems through technology development related to the effects and applications of hazardous materials, noise, and electromagnetic and space radiation used in, or resulting from, Air Force operations. The radiation portion of the project addresses areas such as: safety; risk assessment; mission planning and countermeasures in combat; less than lethal applications for special operations and law enforcement; and biologic effects of exposure to radiofrequency/microwave radiation, lasers, broad-band munitions, and ionizing radiation. Toxicological technology is developed to assess human tolerance levels for chemicals, fuels, and materials to establish exposure criteria and perform trade off analyses between weapon system performance and occupational health and environmental support specifications. Technology to assess and reduce the environmental impact of noise generated by Air Force operations is also developed. This project provides consultative support to other DoD programs by using unique Air Force resources to extend capabilities for development and evaluation of technology to assess and counter toxicological, radiation, and noise hazards.

## (U) FY 1997 (\$ in Thousands):

- (U) \$8,310 Developed technology to exploit the effects and applications of directed energy in Air Force operations.
- (U) Produced interim ultra-short pulse laser safety standard and continued developing technology to assess occupational safety and operational threats from lasers.
- (U) Continued developing electromagnetic radiation bioeffects measurement and analysis methods for use in setting risk-based health and safety standards for personnel exposure.
- (U) Continued developing technologies for assessing bioeffects of less-than-lethal directed energy emissions.
- (U) Developed analytical algorithms for calculating and predicting direct and inverse scattering of laser and radiofrequency radiation. Developed and assessed toxicological technology related to Air Force materials and processes.
- (U) Continued toxicological assessment of next generation replacements for Halons and ozone depleting solvents to protect Air Force personnel and provide systems managers with risk versus benefit decision tools.
- (U) Continued to develop and improve methods and models to assess chemical mixture toxicity in humans, relate human health effects to cleanup standards, and explore indicators of exposure.
- (U) Continued development of metabolic techniques for cell culture exposure, species extrapolation for enzymes diversity, and suitable alternatives to animal use for transition to operational toxicology applications.
- (U) Provided systems managers with critical information for risk versus benefits decision for toxicity of turbine engine exhaust and JP-8 jet fuel.
- (U) \$ 686 Developed technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.

Project 7757

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Exhibit R-2 (PE 0602202F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

**0602202F Armstrong Lab Exploratory**

## PROJECT

7757

- (U) Conducted noise measurements on the F-22 aircraft.
- (U) Developed model to predict damage from sonic booms on historic structures.
- (U) Developed technology to assess human annoyance response to sonic booms and low level aircraft overflights.

(U) FY 1998 (\$ in Thousands):

- |                |                                                                                                                                                                                                                                                     |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) \$ 8,258 | Develop technology to exploit the effects and applications of directed energy in Air Force operations.                                                                                                                                              |
| - (U)          | Initiate probabilistic risk approach to safety for High-Energy Laser Systems.                                                                                                                                                                       |
| - (U)          | Develop electromagnetic radiation bioeffects assessment tools for use in setting scientifically-based health and safety standards for personnel exposure; complete long-term study on ultrawideband exposure and millimeter wave health and safety. |
| - (U)          | Develop technologies for assessing health and safety risks of less-than-lethal directed energy emissions.                                                                                                                                           |
| - (U)          | Develop algorithms for assessing bioeffects of exposure to electromagnetic radiation.                                                                                                                                                               |
| - (U) \$ 5,025 | Develop and assess toxicological technology related to Air Force materials and processes.                                                                                                                                                           |
| - (U)          | Continue to develop toxicological assessments for the ultimate Halon replacements and non-ozone depleting alternative solvents.                                                                                                                     |
| - (U)          | Assess the potential hazards and occupational safety of fuels such as JP-8 and JP-8 + 100.                                                                                                                                                          |
| - (U)          | Develop methodology for extrapolation of chronic exposure data to Short-Term Exposure Limits (STELs).                                                                                                                                               |
| - (U)          | Provide program managers with human health-based data to conduct chemical specific risk assessments.                                                                                                                                                |
| - (U) \$ 750   | Develop technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.                                                                                                                         |
| - (U)          | Demonstrate miniaturized boom monitor that will cut monitoring costs by 80 percent.                                                                                                                                                                 |
| - (U)          | Conduct joint study with Navy to model noise propagation over water.                                                                                                                                                                                |
| - (U)          | Demonstrate radar tracking storage technology for noise analysis.                                                                                                                                                                                   |
| - (U) \$14,033 | Total                                                                                                                                                                                                                                               |

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602202F Armstrong Lab Exploratory  
Development

7757

(U) FY 1999 (\$ in Thousands):

- (U) \$ 4,433 Develop technology to counter laser threats to combat forces and exploit optical systems in Air Force operations.
- (U) Develop risk-based laser safety policy required to support operations.
- (U) Assess developmental reflective aircrew laser eye protection for safe-to-fly and cockpit compatibility requirements.
- (U) Refine joint-Service personnel effects models to assess combatant vulnerability to emerging optical threats.
- (U) Develop guidelines required to deploy non-lethal optical technologies.
- (U) Evaluate Photorefractive Keratectomy (PRK) as surgical method used on aircrew to reduce need for glasses or contact lenses.
- (U) \$ 5,871 Evaluate and exploit the bioeffects of radio frequency radiation (RFR) for military applications.
- (U) Assess the validity of effects and health issues of RFR non-lethal weapons to assure their operational utility, technical feasibility, and policy approval.
- (U) Issue revised safety guidelines for RFR to support fielding of high-power microwave (HPM) and ultrawideband (UWB) weapons.
- (U) Transition advanced dosimetry tools to support all military RFR applications (e.g., radar, communications, directed energy weapons), including revolutionary RFR personnel dosimeter for both safety and threat assessments.
- (U) Apply core competencies in biological mechanistic analysis and electromagnetic bioeffects modeling to discover, develop, and transition new military uses of electromagnetic energy.
- (U) \$ 200 Continue development of technology to assess and reduce adverse impacts of aircraft noise and sonic booms produced by Air Force operations.
- (U) Conduct sensor integration and field testing for remote area monitoring (RAM) system.
- (U) \$ 2,200 Develop and assess deployment toxicology technologies to support Air Force materials and processes.
- (U) Analyze relevant and valid biological markers that indicate possible hazardous chemical exposure to military personnel in a deployment location.
- (U) Develop mathematical predictive tools that accurately describe the human body burden and health implications resulting from operationally relevant single and multiple chemical exposures.
- (U) Develop and validate chemical exposure effects that degrade a military members' ability to perform the mission.
- (U) Assess simulation model for determining operational impact of environmental chemical exposures on fixed base operations.
- (U) \$12,704 Total

Project 7757

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Exhibit R-2 (PE 0602202F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
2 - Applied Research	06022202F Armstrong Lab Exploratory Development	7757																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="0"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>13,936</td> <td>14,751</td> <td>14,443</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>13,921</td> <td>14,033</td> <td>12,704</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602720A, Environmental Quality Technology.</li> <li>- (U) PE 0602777A, Systems Health Hazard Prevention Technology.</li> <li>- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> <li>- (U) PE 0604706F, Life Support Systems.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	13,936	14,751	14,443	Cost	(U) Current Budget Submit/FY 1999 PB	13,921	14,033	12,704	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	13,936	14,751	14,443	Cost														
(U) Current Budget Submit/FY 1999 PB	13,921	14,033	12,704	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

## 0602203F Aerospace Propulsion

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
	Total Program Element (PE) Cost	68,860	57,261	69,061	70,539	73,303	74,520	77,897	Continuing	Continuing
3012	Advanced Propulsion Technology	6,869	0	1,961	1,952	1,945	1,936	1,927	Continuing	Continuing
3048	Fuels and Lubrication	11,785	10,923	11,790	11,799	12,702	14,100	14,372	Continuing	Continuing
3066	Turbine Engine Technology	36,391	31,998	40,745	42,194	42,870	43,241	45,441	Continuing	Continuing
3145	Aerospace Power Technology	13,815	14,340	14,565	14,594	15,786	15,243	16,157	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: As of FY 1998, all ramjet high-speed propulsion efforts under Project 3012, Advanced Propulsion Technology, were terminated, but studies in combined and advanced cycle engines will be continued in FY 1999 and out.

(U) A. **Mission Description and Budget Item Justification:** This Applied Research program develops airbreathing propulsion and aerospace power technologies. The prime areas of focus are turbine engines, dual-mode ramjets, combined cycle engines, fuels, lubricants, and aerospace power technologies. Technology advances in turbine engine propulsion and lubrication systems are part of the Integrated High Performance Turbine Engine Technology (IHPTET) program and will increase engine performance, increase reliability, reduce specific fuel consumption, and lower cost of ownership. Dual-mode ramjet and combined cycle engines will increase weapon lethality and effectiveness against time-critical targets via high-speed propulsion systems. Fuels efforts will reduce system cost, maintenance, and the usage of hazardous cleaning materials while increasing aircraft performance and life through development of thermally stable and high heat sink fuels. High heat sink fuels from coal-derived resources will be investigated. Power system technologies are focused to eliminate troublesome, centralized hydraulic systems by replacement with highly reliable electric systems. Power conditioning, thermal management, and battery improvements will significantly enhance reliability, reduce weight, and lower life cycle costs

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		
2 - Applied Research		0602203F Aerospace Propulsion
PE NUMBER AND TITLE		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	72,221	69,303
(U) Adjustments to Appropriated Value	74,906	60,577
a. Congressional/General Reductions	-1,576	-2,389
b. SBIR	-975	-927
c. Other Adjustments	-3,412	
d. Below Threshold Reprogrammings	-5	
e. Rescissions	-78	
(U) Adjustments to Budget Year Since FY 1998 PB	68,860	57,261
(U) Current Budget Submit/FY 1999 PB		645
		69,061
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to changing priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.		
(U) D. <u>Schedule Profile:</u> Not Applicable.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602203F Aerospace Propulsion								3012	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3012	Advanced Propulsion Technology	6,869	0	1,961	1,952	1,945	1,936	1,927	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> Establishes the technology base for advanced propulsion concepts including integral rocket ramjets for missile propulsion providing increased average velocity and lethality along with combined/advanced-cycle engines and hydrocarbon fueled dual-mode combustion ramjets for high-speed vehicles to support future missions such as rapid strike against time-critical targets. Note: This project was reduced to zero in FY 1998; however, the Air Force reinstated funding in FY 1999 and out and plans to reprogram funds into the project in FY 1998.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$1,817 Developed propulsion system components (inlets, ramburners, nozzles, inlet/port covers, boost motors, etc.) for high-speed airbreathing propulsion applications. This effort facilitates technology transition to current and future air vehicles with greater range, increased velocity, and increased maneuverability which enhance weapon effectiveness.</li> <li>- (U) Completed testing of full-scale flightweight consumable structures for eliminating debris during rocket/ramjet transition.</li> <li>- (U) Determined applicability and quantified benefits of advanced ramjet propulsion technologies (insensitive munitions, low-observables, self throttling, high energy fuels, structures, etc.) for ramjet operation from launch condition through Mach 6 operation.</li> <li>- (U) Tested a boilerplate pulse detonation engine operating at realistic frequencies, thrust levels, and for sufficient time to demonstrate cycle performance.</li> <li>- (U) \$2,211 Investigated advanced concepts and develop engine components (dual-mode combustors, fuel injectors, flameholding systems, etc.) for supersonic combustion ramjet (scramjet) applications. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.</li> <li>- (U) Determined propulsion performance of dual-mode ramjet components utilizing advanced test technologies, instrumentation, and diagnostics.</li> <li>- (U) Investigated, further developed, and exploited Russian hypersonic technology.</li> </ul>											

Project 3012

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Exhibit R-2 (PE 0602203F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602203F Aerospace Propulsion	3012	
- (U) \$2,841	Investigated unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.		
- (U)	(U) Completed fabrication and initiated testing of annular sector test rig to demonstrate performance of critical combustor components for application to Mach 0-6 turbofanjet engines.		
- (U)	(U) Completed conceptual design of combined cycle engine demonstrator.		
- (U)	(U) Tested a boilerplate pulse detonation engine operating at realistic frequencies, thrust levels, and for sufficient time to demonstrate cycle performance.		
- (U) \$6,869	Total		
(U) FY 1998: Not Applicable.			
(U) FY 1999 (\$ in Thousands):			
-(U) \$729	Investigate unique concepts for combining advanced propulsion cycles which provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.		
- (U)	(U) Conduct airbreathing propulsion support study for advanced dual-range missile to potentially increase range.		
- (U)	(U) Conduct combined cycle engine trade studies for aircraft, missile, and spacelift applications to determine potential areas for future investment.		
- (U) \$396	Investigate, further develop, and exploit Russian hypersonic technology. This effort supports technology transition for next generation hypersonic missiles and air vehicles to provide greater range and increased velocity which enhance weapon effectiveness.		
- (U)	Exploit plasma effects to reduce engine drag and enhance combustion initiation.		
- (U)	Conduct investigation of magnetohydrodynamic flow acceleration to enhance scramjet thrust generation.		
- (U) \$836	Exploit Russian advances in endothermic fuels to provide high Mach operation using conventional jet fuel.		
- (U)	Investigate unique pulse detonation engine concepts to provide the capability for takeoff, acceleration, cruise, and target loiter for high-speed aerospace vehicles. This effort supports technology transition for next generation reconnaissance/strike vehicles (manned and unmanned) and airbreathing boosters.		
- (U)	(U) Conduct Pulse Detonation Engine (PDE) experiments and trade studies to optimize PDE performance to provide lower cost, higher performance alternative to turbine engines for expendable weapon applications.		
- (U) \$1,961	Total	(U) Investigate potential for combining airbreathing and rocket pulse detonation engines to provide lower cost access to space.	

Project 3012

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Exhibit R-2 (PE 0602203F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602203F Aerospace Propulsion

3012

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	7,179	0	0	Cost
(U) Current Budget Submit/FY 1999 PB	6,869	0	1,961	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to emphasis on Advanced Propulsion technologies within the Science and Technology (S&T) Program. Note: This project was reduced to zero in FY 1998; however, the Air Force reinstated funding in FY 1999 and out and plans to reprogram funds into the project in FY 1998.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) executive committee.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 3012

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602203F Aerospace Propulsion

PROJECT

3048

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3048 Fuels and Lubrication	11,785	10,923	11,790	11,799	12,702	14,100	14,372	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops advanced fuels, lubricants, and component technologies for use in aircraft and missile engines. Conventional petroleum and alternate fuels are developed and evaluated for Air Force applications. Fuels and lubricants must be thermally stable, cost-effective, and operate at higher temperatures.

(U) FY 1997 (\$ in Thousands):

- (U) \$4,482

Developed high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

- (U) Validated performance and cost benefits of JP-8+100 fuel to increase sortie generation.

- (U) Validated advanced fuel system components that allow the utilization of the heat sink of JP-8+100 fuel.

- (U) Continued effort in coal-derived fuel Research and Development.

- (U) \$2,668

Developed high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

- (U) Established combustor design rules through characterization of a high performance, low emissions six-inch sector of a trapped vortex combustor (TVC) at atmospheric pressure and utilized these rules to design a high pressure full-scale TVC sector.

- (U) Constructed a high temperature, high pressure combustion facility to test full-scale combustor sectors for advanced turbine engines.

- (U) Evaluated fuel injector concepts in a low pressure combustion rig to fully characterize combustion performance and emissions levels.

Developed lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

- (U) Verified vapor phase lubrication as primary system in expendable and limited life gas turbine engines.

- (U) Verified magnetic levitation and control as full replacement for conventional lubricants and bearings in an advanced gas generator.

- (U) \$11,785

Total

Project 3048

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Exhibit R-2 (PE 0602203F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602203F Aerospace Propulsion

PROJECT

3048

(U) FY 1998 (\$ in Thousands):

- (U) \$6,297

Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.

- (U) Evaluate fuel additives to increase the high temperature stability of fuels above 425°F.

- (U) Validate advanced fuel system components that allow the utilization of the heat sink of JP-8+100 and other high heat sink fuels.

- (U) Continue effort in coal-derived fuel Research and Development.

- (U) \$1,846

Develop high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.

- (U) Evaluate high performance, low emissions, full-scale sector of a trapped vortex combustor for transition to advanced turbine engines.

- (U) Evaluate effectiveness of a high temperature fuel/air heat exchanger for cooling turbine vanes at the exit of a trapped vortex combustor.

- (U) Establish combustor design rules through characterization of a high performance, low emissions six-inch sector of an integrated lightweight combustor (ILC) at atmospheric pressure and utilize these rules to design a high pressure full-scale ILC sector.

- (U) \$2,780

Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.

- (U) Demonstrate advanced liquid lubricant, fully functional from -40°F to +600°F, in test engine.

- (U) Integrate vapor phase lubricant system into expendable-class engine demonstrator for full operational evaluation.

- (U) Develop a fully integrated rotor support and control system based on a high temperature, hybrid (magnetic/mechanical) bearing set.

- (U) \$10,923

Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602203F Aerospace Propulsion	3048	
<p>(U) FY 1999 (\$ in Thousands):</p> <p>- (U) \$4,407 Develop high thermal stability hydrocarbon fuels to provide higher heat capacity and operating temperatures for aircraft and missile systems. This technology is for current and future aircraft to reduce fuel systems fouling/coking, and provide cooling for increased avionics loads, higher engine temperatures, and reduced fuel consumption.</p> <p>- (U) Evaluate advanced fuel additives to increase fuel thermal stability to 900 °F.</p> <p>- (U) Evaluate fuel system components that utilize the heat sink of supercritical fuels.</p> <p>- (U) \$2,573 Develop high performance, low emissions, robust combustor concepts for advanced turbine engines. This will reduce the risk and cost associated with developing high performance, low maintenance engines that operate efficiently within air pollution guidelines and have high thrust-to-weight ratio and low specific fuel consumption.</p> <p>- (U) Evaluate high performance, low emissions, full-scale sector of a trapped vortex combustor using a microwave ignition system.</p> <p>- (U) Evaluate effectiveness of an endothermic fuel/air heat exchanger for cooling turbine vanes at the exit of an integrated lightweight combustor (ILC).</p> <p>- (U) Evaluate high performance, low emissions, full-scale sector of an ILC for transition to advanced turbine engines.</p> <p>- (U) \$4,810 Develop lubricant technology to permit efficient high-speed rotation of turbine engine components. This technology includes conventional and advanced lubricants, and mechanical systems extended to their highest temperature limitations and approaches, such as magnetic levitation and solid and vapor lubrication for advanced engines with operating conditions that exceed the capabilities of conventional approaches.</p> <p>- (U) Complete transition of advanced, broad temperature range, liquid lubricant to a fully qualified, field-ready material.</p> <p>- (U) Evaluate vapor phase lubricants for piloted, unlimited life applications.</p> <p>- (U) Integrate hybrid magnetic bearing into a core (high pressure), single spool demonstrator engine.</p> <p>- (U) Develop hybrid magnetic bearing for full control of a low pressure rotor in preparation for fully integrated, hybrid magnetic bearing supported, dual-spool engine demonstrator.</p> <p>- (U) \$11,790 Total</p>			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 2 - Applied Research

0602203F Aerospace Propulsion

3048

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	12,511	13,577	12,161	Cost
	11,785	10,923	11,790	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602203F Aerospace Propulsion

PROJECT

3066

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3066 Turbine Engine Technology	36,391	31,998	40,745	42,194	42,870	43,241	45,441	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops technology to increase propulsion system operational reliability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental efforts are conducted in fans/compressors, high temperature combustors, turbines, internal flow systems, controls, exhaust systems, and structural design. This project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program.

(U) FY 1997 (\$ in Thousands):

- (U) \$24,783 Developed core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) Demonstrated advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
- (U) Demonstrated advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
- (U) Demonstrated advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) \$6,494 Developed turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) Demonstrated advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) \$2,632 Developed components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) Demonstrated advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.

Project 3066

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Exhibit R-2 (PE 0602203F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602203F Aerospace Propulsion

3066

- (U) \$2,482

Developed components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.

- (U) Demonstrated advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.

- (U) \$36,391

Total

(U) FY 1998 (\$ in Thousands):

- (U) \$28,948

Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.

- (U) Design and fabricate Integrated High Performance Turbine Engine Technology (IHPTET) Phase III advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.

- (U) Design and fabricate IHPTET Phase III advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.

- (U) Design and fabricate IHPTET Phase III advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.

- (U) \$3,050

Develop turbine engine components (fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.

- (U) Design and fabricate IHPTET Phase III advanced fan with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.

- (U) \$31,998

Total

Project 3066

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602203F Aerospace Propulsion

PROJECT

3066

## (U) FY 1999 (\$ in Thousands):

- (U) \$28,575 Develop core engine components for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) Demonstrate Integrated High Performance Turbine Engine Technology (IHPTET) Phase III advanced compressors with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher compressor exit temperature capability, lower weight, and improved seals.
- (U) Demonstrate IHPTET Phase III advanced combustors with higher combustion efficiencies, lower manufacturing costs, increased robustness, higher combustion temperature, lower weight, and improved temperature patterns.
- (U) Demonstrate IHPTET Phase III advanced turbines with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) \$6,765 Develop turbine engine components (fans, low pressure turbines, engine controls, and integration technology) for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports. These components will provide aircraft engines with higher performance, increased durability, reduced fuel consumption, and lower life cycle cost.
- (U) Conduct advanced fan component development with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) Conduct advanced low spool turbine component development with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) Design and fabricate IHPTET Phase III advanced controls and exhaust nozzles with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, lower weight, and improved cooling effectiveness.
- (U) \$2,782 Develop components for expendable engines for missile and unmanned air vehicle applications. These components will provide expendable engines with reduced cost, reduced fuel consumption, and increased specific thrust, greatly expanding the operating envelopes of cruise missiles.
- (U) Design and fabricate IHPTET Phase III advanced combustor with higher aerothermodynamic efficiencies, lower manufacturing costs, increased robustness, and lower weight.
- (U) \$2,623 Develop components for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, and theater transports.
- (U) Design and fabricate IHPTET Phase III advanced turbine with higher aerodynamic efficiencies, lower manufacturing costs, increased robustness, higher turbine inlet temperature, lower weight, and improved cooling effectiveness.
- (U) \$40,745 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602203F Aerospace Propulsion

3066

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	37,980	40,613	41,357	Cost
	36,391	31,998	40,745	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary (\$ in Thousands):(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) PE 0602122N, Aircraft Technology.
- (U) PE 0603210N, Aircraft Propulsion.
- (U) PE 0603003A, Aviation Advanced Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602203F Aerospace Propulsion

PROJECT

3145

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3145 Aerospace Power Technology	13,815	14,340	14,565	14,594	15,786	15,243	16,157	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops technologies for aerospace power generation, conversion, and transmission systems including advanced electrical power component and subsystem technologies. Power components are developed for aircraft and flight line equipment to increase reliability, maintainability, commonality, and supportability. This project supports an initiative which uses electrical power to replace hydraulic and pneumatic power and their costly logistics support. These electrical power technologies are necessary to meet the 10-20 year long-term storage requirements of Air Force uninhabited combat aerial vehicles (UCAVs). Electrical power generation technologies developed are enabling technologies all future military directed energy (DE) weapon systems. Essentially, all power electronics (conversion) technology being developed here has dual-use opportunities. Spin-off application areas include all military system conversion development from conventional to electrically-based on-board subsystems.

## (U) FY 1997 (\$ in Thousands):

- (U) \$12,033 Developed aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
- (U) Demonstrated electrical components essential for a fault tolerant electrical power system.
- (U) Completed test and demonstration of high temperature semiconductor switches to demonstrate increased operating temperature and improved reliability.
- (U) Completed fabrication of internal engine starter/generator which leads to elimination of engine gear box.
- (U) \$1,247 Developed battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
- (U) \$535 Demonstrated lithium cells for use in rechargeable batteries--allows three-fold reduction in mass and volume over existing batteries. Developed special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
- (U) Developed next generation electrical conductors with 50% increase in current density and higher operating temperature for advanced lightweight electrical generators.
- (U) \$13,815 Total

Project 3145

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602203F Aerospace Propulsion	3145	

(U) FY 1998 (\$ in Thousands):	
- (U) \$12,327	Develop aerospace batteries and power generation, conversion, and transmission components for aircraft systems. These components provide aircraft with a high degree of self-sufficiency, improved reliability, maintainability, and supportability, all yielding a quicker aircraft turn-around time. In addition, ground support equipment requirements will be dramatically reduced.
- (U) \$1,505	- (U) Develop advanced power generation, conversion, and distribution components for a fault tolerant electrical power system.
	- (U) Begin testing internal engine starter/generator which leads to elimination of engine gear box.
	Develop battery systems for guidance, navigation, control functions for missile systems, and for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide missiles systems and special operations forces with greater reliability and reduced maintenance costs.
- (U) \$508	- (U) Develop new cathode materials for lithium batteries to enhance cycle life.
	Develop special purpose power components for advanced surveillance and communications systems, as well as ground power applications.
- (U) \$14,340	- (U) Develop improved ceramic processing of coated conductors to optimize crystallization of conductors.
	Total

(U) FY 1999 (\$ in Thousands):	
- (U) \$12,350	Develop power generation components for aircraft systems. These components improve aircraft self-sufficiency, reliability, maintainability, and supportability.
- (U) \$1,730	- (U) Complete initial testing of the internal engine starter/generator rig demonstration which leads to elimination of engine gear box. Develop battery components for use in navigational aids, radios, and sensors for special operations forces. Batteries with higher power density, longer life, increased reliability, and rechargability will provide special operations forces with greater reliability and reduced maintenance costs.
- (U) \$485	- (U) Evaluate performance for lithium cells and down-select based on performance of cathode material.
	Develop special purpose power components for advanced directed energy weapon systems, as well as ground power applications.
- (U) \$14,565	- (U) Evaluate conductors produced under new process which will provide 25% improved current density and 15% increase in operating temperature capability.
	Total

Project 3145

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
2 - Applied Research		0602203F Aerospace Propulsion		3145	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>					
		FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)		14,551	15,113	14,898	Cost
(U) Current Budget Submit/FY 1999 PB		13,815	14,340	14,565	Cont
(U) Change Summary Explanation:					
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.					
Schedule: Not Applicable.					
Technical: Not Applicable.					
(U) C. <u>Other Program Funding Summary:</u>					
(U) Related Activities:					
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.					
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.					
(U) D. <u>Schedule Profile:</u> Not Applicable.					

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY											
2 - Applied Research											
PE NUMBER AND TITLE											
0602204F Aerospace Avionics											
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
Total Program Element (PE) Cost	63,953	61,025	65,549	67,461	72,064	73,182	75,279	Continuing	Continuing		
2000 Electronic Countermeasures Technology	13,141	14,570	15,917	16,882	17,405	17,944	18,319	Continuing	Continuing		
2001 Electro-Optical Technology	8,780	6,134	490	0	0	0	0	Continuing	Continuing		
2002 Microwave Technology	8,489	9,613	9,341	9,092	10,561	10,011	10,212	Continuing	Continuing		
2003 Avionics System Design Technology	8,233	6,317	9,498	10,070	10,459	10,751	11,029	Continuing	Continuing		
6095 Information Fusion Technology	9,771	7,486	11,606	12,729	13,604	14,368	15,120	Continuing	Continuing		
6096 Microelectronics Technology	7,586	9,273	9,475	8,906	9,874	9,679	9,898	Continuing	Continuing		
7622 Radio Frequency Sensor Technology	7,953	7,632	9,222	9,782	10,161	10,429	10,701	Continuing	Continuing		
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

Note: For FY 1998 and beyond, several projects in this PE have been combined. For clarity, the FY 1997 portions of this exhibit have used the new project structure. Project 2000, Active Electronic Countermeasures, and Project 7633, Passive Electronic Countermeasures, have been combined within Project 2000, Electronic Countermeasures Technology. Project 2001, Electro-Optical Technology, and Project 2004, Reconnaissance/Strike Electro-Optical Sensors, have been combined within Project 2001, Electro-Optical Technology. (After FY 1999, Project 2001 will terminate due to budget constraints and priorities within the Science and Technology Program.) Project 6095, Inertial Reference and Guidance Technology, and Project 7629, Fire Control Avionics, have been combined within Project 6095, Information Fusion Technology. Project 7622, Reconnaissance Strike Radio Frequency Sensors, and Project 7662, Avionics Data Transmission and Reception, have been combined within Project 7622, Radio Frequency Sensor Technology.

(U) **A. Mission Description and Budget Item Justification:** This Applied Research program develops the technology base for Air Force aerospace avionics. Advances in aerospace avionics are required to increase combat effectiveness, reduce life cycle costs, facilitate modernization of aging and future aerospace platforms, and provide protection against emerging hostile threat systems. Meeting these needs necessitates simultaneous advances in multiple, interrelated disciplines including: airborne sensors (e.g., infrared, radar, etc.); multi-function high-power electronic devices; target detection, classification, and recognition; fire control; communication and navigation subsystems; and electronic warfare technologies. To permit new capabilities to transition smoothly to warfighters, this program also develops avionics architectures, data processing technologies, and sensor integration techniques. This investment strategy will permit the Air Force to move away from costly independent "black box" avionics to open system avionics that combine common modules, shared components, and commercial devices into integrated, easily-upgradable systems. Advanced, integrated avionics technologies will give warfighters the combat edge they need at an affordable price. Note: In FY 1998, Congress added \$2.0 M for Environmental Laser Mapping.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

0602204F Aerospace Avionics

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	65,360	69,401	70,469	Cost
(U) Appropriated Value	68,061	64,144		Cont
(U) Adjustments to Appropriated Value				Cont
a. Congressional/General Reductions	-1,444	-2,464		
b. SBIR	-1,134	-655		
c. Omnibus/Other Above Threshold Reprogrammings	-1,460			
d. Below Threshold Reprogrammings				
e. Rescissions	-70			
(U) Adjustments to Budget Year Since FY 1998 PB			-4,920	
(U) Current Budget Submit/FY 1999 PB	63,953	61,025	65,549	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									PROJECT
2 - Applied Research		0602204F Aerospace Avionics									2000
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2000	Electronic Countermeasures Technology	13,141	14,570	15,917	16,882	17,405	17,944	18,319	Continuing	Continuing	

(U) **A. Mission Description and Budget Item Justification:** This program determines the feasibility of active and passive electronic countermeasure technologies and explores, develops, expands, and refines the most promising and cost-effective technologies. The technologies pursued support passive sensing of the entire electromagnetic spectrum in order to provide signal collection, detection, recognition, analysis, identification, location, and countering of enemy electronic emissions whether intentional or unintentional. This project includes development of countermeasure concepts against radar, infrared (IR), and electro-optical threat weapon systems as well as against communication command and control networks. Various links and sensors of threat air defense systems are analyzed and a database of countermeasure techniques and technologies is generated from which specific self-protection or support countermeasures equipment can be developed. Specifically, the program exploits emerging technologies to provide increased capability for: 1) radar warning, radio frequency (RF) electronic warfare, and electronic intelligence applications; 2) IR detection for passive missile warning, IR signature exploitation, and IR countermeasures; 3) laser detection for threat warning and countermeasures; 4) passive and combined passive/active off-board expendables (chaff, decoys, etc.); and 5) hardware and software for associated processing and technology integration needs. These countermeasure capabilities are vital for survival of operational aerospace platforms facing advanced threats in future hostile environments.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,888 Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles.
- (U) Continued development and in-house evaluation of on-board IR countermeasures against imaging missile seekers.
- (U) Continued development of IR flare technology using advanced materials.
- (U) Continued to develop concepts for countermeasures against laser beamrider missiles.
- (U) Continued to develop concepts for countermeasures against night vision devices which are used to augment IR missile launchers.
- (U) Develop off-board RF countermeasures concepts (active decoys) for affordable survivability against radar threats.
- (U) Tested active decoys using advanced jamming modulations tailored to counter coherent radar threats.
- (U) Identified countermeasures techniques and technology for decoys operating in the high-millimeter band frequency range.
- (U) \$1,439 Develop affordable, on-board RF technology and concepts to achieve solutions to countermeasures requirements related to radar-controlled lethal threat systems.
- (U) Investigated integrated angle, doppler, and range deception techniques to effectively jam coherent monopulse threat tracking radars.
- (U) Fabricated and tested narrow-band, digital RF memory architecture.
- (U) Tested and evaluated a unique modulation component for digital jamming.
- (U) \$1,916

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	2000	
- (U) \$1,709	Develop on-board radio frequency (RF) countermeasures against voice and data communications elements of enemy air defense systems.		
- (U) \$1,855	- (U) Fabricated and tested broadband hardware to jam the special data signals used for command and control of lethal threat systems. Develop technology for generic hardware and software modules to enable low-cost block upgrades to electronic warfare (EW) receivers.		
- (U) \$1,471	- (U) Ground-tested combined de-interleaving, correlation, and threat identification software modules. - (U) Ran initial concept tests for threat parameter normalization software.		
- (U) \$1,559	Develop all-digital EW receiver and associated antenna for improved reliability and flexibility in response to ever changing EW threats.		
- (U) \$1,304	- (U) Evaluated fundamental angle and RF hardware correlator for improved performance and reliability. - (U) Continued to develop angle/frequency discrimination concepts to respond to new threat signals.		
- (U) \$13,141	Develop an enhanced warning capability with advanced detector and processing technology and integrated missile warning, laser warning, and targeting sensors for an improved pilot protection capability. - (U) Developed low-cost multicolor infrared (IR) filtering technique for IR focal plane array system. Continue development of models for off-board, expendable electronic countermeasures for use in chaff and decoy dispensing programs. - (U) Flight-tested "environmental chaff" for use in combat training exercises. - (U) Developed broadband for advanced, passive, expendable, off-board countermeasures. Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$3,363	Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles and electro-optical directed threat systems.		
- (U) \$4,126	- (U) Continue development and in-house evaluation of on-board IR countermeasure against imaging missile seekers. - (U) Initiate development of a shielded narrowband IR source for advanced IR decoys to minimize out-of-band detection. - (U) Complete analysis of laser beamrider missile countermeasure concepts and downselect for laboratory and field testing. - (U) Conduct laboratory tests demonstrating effects of countermeasure concepts against enemy night vision devices. - (U) Continue to develop cooperative on-board and off-board IR countermeasure concepts for synergistic effects. Develop affordable radio frequency (RF) jamming technology and concepts which degrade enemy radar, missiles, and command and control systems. This will enhance aircraft survivability. - (U) Test countermeasures to effectively and affordably degrade monopulse threat tracking radars to assure survivability of our aircraft. - (U) Continue evaluation of digital RF memory architecture to provide the capability to defeat coherent doppler fire control radars. - (U) Develop digital jamming pulse quality metrics to enhance evaluation of countermeasure technique effectiveness. - (U) Investigate concepts for countermeasures against covert threat communication links that use featureless waveforms. - (U) Conduct in-house evaluation of RF countermeasure techniques to defeat advanced radar, missile, and communication threats.		

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Exhibit R-2 (PE 0602204F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602204F Aerospace Avionics

2000

- (U) \$771 Develop off-board (expendable) RF countermeasure concepts for affordable survivability against radar threats.
  - (U) Design active decoys to counter surface and airborne threats using microwave and millimeter wave radars.
  - (U) Continue development of design tools and analytic methods to predict the effectiveness of advanced chaff payloads, dispensing methods, and tactics.
  - (U) Develop and test environmentally degradable and electromagnetically tailorable chaff designs to allow for the resumption of chaff usage during combat training exercises and to provide advanced countermeasure techniques.
- (U) \$1,542 Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers.
  - (U) Continue ground-testing combined de-interleaving, correlation, and threat identification software modules to detect new threat systems without expensive hardware upgrades.
  - (U) Complete preliminary design of advanced threat parameter normalization software to allow aircraft to share situational awareness data.
- (U) \$3,854 Develop affordable RF receiver and antenna technology for use in operational and future aircraft. This technology is needed to detect, characterize, and identify threats in increasingly complex environments while maintaining own aircraft covertness and emission control.
  - (U) Complete testing of wideband digital receiver brassboard to affordably increase threat coverage.
  - (U) Continue development of wideband receiver specialized software for threat characterization, identification, and location.
  - (U) Develop narrowband digital receiver technology to provide a limited capability to inexpensively update operational systems.
  - (U) Complete design of a six to eight gigahertz, low-profile (less than one inch) conformal antenna array and investigate its electromagnetic characterization.
  - (U) Transition software for design and evaluation of flush-mounted conformal arrays.
- (U) \$914 Develop missile and laser warning technology to accurately cue countermeasures, improving survivability.
  - (U) Continue development of laser warning discrimination techniques for countermeasure cueing.
  - (U) Continue evaluation of infrared (IR) clutter rejection techniques for two times improvement in IR missile warning range.
  - (U) Continue development and evaluation of multi-frequency, non-mechanical filters for fifty percent reduction in false alarm rates.
  - (U) Complete development of laser warning breadboard.
- (U) \$14,570 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$4,846 Develop technologies for on-board and off-board (active IR decoys) countermeasures to counter IR-guided missiles and electro-optical directed threat systems.
  - (U) Continue development and in-house evaluation of on-board IR countermeasure against imaging missile seekers.
  - (U) Conduct laboratory tests of laser beamrider missile countermeasure concepts.
  - (U) Continue to develop cooperative on-board and off-board IR countermeasure concepts.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	2000	
- (U) \$2,677	Develop affordable radio frequency (RF) jamming technology and concepts which degrade enemy radar, missiles, and command and control systems. This will enhance aircraft survivability.		
	<ul style="list-style-type: none"><li>- (U) Develop new, multifunction RF waveforms for flexible countermeasures against unexpected/unknown threats systems.</li><li>- (U) Continue developing advanced deception countermeasures techniques to assure capability to degrade new/upgraded threat radars.</li><li>- (U) Develop techniques to degrade modern communications networks used for enemy command and control.</li><li>- (U) Conduct in-house laboratory evaluation of RF countermeasure techniques to defeat advanced radar, missile, and communication threats.</li></ul>		
- (U) \$305	Develop off-board (expendable) RF and combined IR/RF countermeasure concepts for affordable survivability against radar threats.		
	<ul style="list-style-type: none"><li>- (U) Continue design of active decoys to counter surface and airborne threats using microwave and millimeter wave radars.</li><li>- (U) Demonstrate advanced active or passive expendable techniques that decoy tracking radars away from our aircraft.</li></ul>		
- (U) \$2,095	Develop technology for generic software modules to enable low-cost block upgrades to electronic warfare receivers.		
	<ul style="list-style-type: none"><li>- (U) Demonstrate combined de-interleaving, correlation, and threat identification software modules.</li><li>- (U) Develop next-generation receiver algorithms to leverage flexible, digital receiver architectures.</li></ul>		
- (U) \$4,689	Develop affordable radio frequency (RF) receiver and antenna technology for use in operational and future aircraft. This technology is needed to detect, characterize, and identify threats in increasingly complex environments while maintaining own aircraft covertness and emission control.		
	<ul style="list-style-type: none"><li>- (U) Develop new techniques for wideband to narrowband receiver cueing.</li><li>- (U) Demonstrate first wideband all-digital receiver.</li><li>- (U) Demonstrate dual-use conformal array technology and continue electromagnetic characterization.</li></ul>		
- (U) \$1,305	Develop missile and laser warning technology to accurately cue countermeasures, improving survivability.		
	<ul style="list-style-type: none"><li>- (U) Develop laser warning discrimination techniques for cueing countermeasures.</li><li>- (U) Continue evaluation of infrared (IR) clutter rejection techniques for improved IR missile warning.</li><li>- (U) Continue development of multi-color, non-mechanical filters for IR missile warning.</li></ul>		
- (U) \$15,917	Total		

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Exhibit R-2 (PE 0602204F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602204F Aerospace Avionics

2000

(U) B. Program Change Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	Total
(U) Previous President's Budget (FY 1998 PB)	13,235	15,562	16,250	Cost
(U) Current Budget Submit/FY 1999 PB	13,141	14,570	15,917	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603270F, Electronic Combat Technology.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 2000

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Exhibit R-2 (PE 0602204F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602204F Aerospace Avionics								2001	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2001	Electro-Optical Technology	8,780	6,134	490	0	0	0	0	Continuing	Continuing	

(U) **A. Mission Description and Budget Item Justification:** This project focuses on the development of military unique and essential devices and components for airborne optical sensing, optical processing, and integration of electro-optical technology into avionics sensor systems. Electro-optical technologies provide faster, more accurate detection and targeting capability combined with the benefits of low weight and low-power requirements. The results of this technology provide the warfighter with increased situational awareness, enhanced defense suppression, and improved precision weapon delivery. Note: In FY 1998, Congress added \$2.0 M for Environmental Laser Mapping.

(U) **FY 1997 (\$ in Thousands):**

- (U) \$1,863 Develop short pulse infrared and ultraviolet source technologies for target recognition and designation.
- (U) \$1,490 Develop high-throughput, real-time optical processing technology to improve precision in imaging and target recognition.
- (U) \$1,603 Develop and evaluated sources and components for greater speed and testability of optical subsystems.
- (U) \$931 Develop ultraviolet technology for imaging, tracking, and jet engine analysis.
- (U) \$585 Develop advanced electro-optical sensor technology for combined navigation and air-to-ground targeting in a multi-function sensor. This thrust is aimed at alleviating the weight, drag, maintenance, and cost problems of a dual sensor approach.
- (U) \$2,308 Completed development of algorithms that can perform targeting on multiple scenes at the same time.
- (U) \$8,780 Completed development of electronic stabilization algorithms allowing for range enhancement of electro-optical sensor technology for combined navigation and air-to-ground targeting.
- (U) \$585 Develop and demonstrate a low-cost, maintainable, high performance, non-mechanical method of directing the passive sensor field of view. Mechanical methods of scanning the target scene are inherently bulky, expensive, and unreliable. A non-mechanical approach will also permit the use of low-cost staring focal plane arrays which will enhance overall performance.
- (U) \$2,308 Completed the design, fabrication, and absolute pointing accuracy verification of a phased array beam steering component. Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and air-to-air sensor performance, target detection ranges, and identification.
- (U) \$8,780 Completed application and requirements analysis of electro-optical technologies for precision targeting of ground-based and airborne threats.
- (U) \$8,780 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602204F Aerospace Avionics

PROJECT

2001

(U) FY 1998 (\$ in Thousands):

- (U) \$1,284 Develop ultraviolet technology for applications such as missile threat warning, communications, and jet engine analysis.
  - (U) Continue to develop solid state laser technology for a safer, high-power, more reliable, ultraviolet source in one-fifth the size.
  - (U) Develop solar-blind, ultraviolet detector technology for smaller, higher performance missile warning receivers with significantly reduced false alarm rates.
- (U) \$311 Develop high-speed opto-electronics technology for faster interfaces between electronic components. Applications include high-speed data processing, analog to digital converters, digital radar, and real-time image and target recognition. These development efforts are jointly planned with the Defense Advanced Research Projects Agency.
  - (U) Develop optical interconnect technology for high-speed electronic and opto-electronic multichip modules that will provide four times data rate increase with greater antenna to processor distances for digital radar applications.
  - (U) Develop optical lithography technology for the fabrication of high-speed, integrated electronics and opto-electronic multichip modules with increased resolution and five times faster throughput at one-tenth the cost.
- (U) \$747 Develop affordable, supportable, manufacturable high definition/resolution displays with the following performance characteristics: all digital interface; sunlight readability; and high reliability.
  - (U) Demonstrate technology to increase the optical efficiency of active matrix liquid crystal displays by at least a factor of two.
  - (U) Continue adapting low-cost, commercial-based, digital display interface to drive high definition military displays.
  - (U) Continue development of large area, high resolution, sunlight readable cockpit field emission display.
  - (U) Begin development of flat panel head-up display (HUD) to improve reliability over existing cathode ray tube HUDs and explore replacement of classical optics with lighter, more compact diffractive projection optics.
- (U) \$1,369 Develop advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
  - (U) Complete design and begin fabrication of a multi-function sensor, incorporating multiple apertures, with a three times improvement in target detection range and four times improvement in identification range.
- (U) \$2,433 Develop and demonstrate frequency agile electro-optical technologies to enhance air-to-ground and to air-to-air sensor performance, increase target detection and identification ranges, and defeat heat-seeking missiles.
  - (U) Demonstrate, through ground and airborne experiments, the value of modular wind profiling to cargo and bomb drop applications.
  - (U) Develop narrow bandwidth, tunable infrared (IR) source technology for multispectral sensing.
  - (U) Develop first-generation coatings to enhance the reliability of mid-IR optics.
  - (U) Complete preliminary design of a compact, medium-range, airborne laser radar to detect small concentrations of pollutants and chemical agents.
- (U) \$6,134 Total

Project 2001

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 2 - Applied Research

0602204F Aerospace Avionics

2001

(U) FY 1999 (\$ in Thousands):

- (U) \$490 Develop advanced electro-optical sensor technologies, including non-mechanical beam steering techniques, for a single compact, affordable navigation and targeting sensor.
- (U) Complete fabrication and begin laboratory testing multi-function sensor.
- (U) \$490 Total

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	8,860	5,749	4,394	Cost
(U) Current Budget Submit/FY 1999 PB	8,780	6,134	490	Cont

(U) Change Summary Explanation:

Funding: After FY 1999, this Project will terminate due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0602702F, Command, Control, and Communications.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0602712E, Materials and Electronics Technology.
- (U) PE 0603739E, Advanced Electronics Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 2001

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602204F Aerospace Avionics

PROJECT

2002

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2002 Microwave Technology		8,489	9,613	9,341	9,092	10,561	10,011	10,212	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project focuses on the generation, control, reception, and processing of microwave and millimeter wave power. Develops technologies such as solid state and vacuum electronic power devices and amplifiers, low noise and signal control components, high-temperature electronics, multi-function monolithic integrated circuits, and high density packaging and interconnects. Develops techniques for integrating various combinations of these technologies to demonstrate significantly improved performance with smaller size, lower weight, lower cost, and higher reliability in military-specific applications. The requirements for device and component technology developments are based on Air Force and other DoD weapon systems needs in the areas of radar, communications, electronic warfare (EW), navigation, and smart weapons applications.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,623 Develop mixed-mode, microwave/digital multi-function integrated circuits components for radar and EW receivers and for digital phased array radars.
- (U) Continued to develop advanced analytical methods for evaluating mixed-mode integrated components.
- (U) Designed and developed mixed-mode signal control component for reduced weight and volume of airborne receiver systems.
- (U) \$2,013 Develop high-power, solid state amplifiers for radar and communications applications.
- (U) Designed and developed high-power, high-efficiency amplifiers for phased array radars which increase the performance and efficiency in the 1-20 gigahertz frequency band.
- (U) Developed high-power transmit amplifiers for precision guided weapons.
- (U) Developed advanced transistors and fabrication techniques for microwave power amplifiers that produce higher power (via improved heat dissipation) for compact, reliable, and affordable radio frequency sensors.
- (U) \$1,708 Develop reliable, high-operating-temperature electronics for microwave transmitters used in airborne applications.
- (U) Continued development of candidate materials that will improve the reliability of microwave transistors.
- (U) Developed integrated circuits for reliable, high-power operation of advanced EW and radar applications.
- (U) \$1,496 Develop high-power vacuum electronics devices and components for EW, radar, and communications applications.
- (U) Fabricated components for advanced microwave tubes to improve reliability of radio frequency subsystems.
- (U) Continued fabrication and testing of millimeter wave power modules to increase range capability of communications and electronic combat transmitters over the 20 to 40 gigahertz frequency range.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	2002
2 - Applied Research	0602204F Aerospace Avionics		
- (U) \$1,649	Develop millimeter wave integrated circuits for terminal guidance and communications systems.		
- (U) \$8,489	- (U) Continued development and initiated test of integrated circuit signal control components to improve the performance and reliability of millimeter wave terminal guidance radars.		
	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,550	Develop military essential mixed-mode (e.g., high-power/low-noise, microwave/digital, electronic/electro-optical, etc.) multi-function components for radar and electronic warfare (EW) receivers and for digital phased array radars. Application of this compact and more flexible sensor technology will improve warfighter situational awareness, enhance defense suppression, and improve precision weapon delivery.		
- (U) \$3,220	- (U) Evaluate and validate advanced analytical methods for designing integrated analog/digital components to reduce non-recurring engineering costs for systems such as high performance radar and EW receivers.		
	- (U) Fabricate miniature digital receivers which will reduce the weight and volume of airborne receiver systems and enhance situational awareness by increasing target detection/tracking sensitivity.		
	Develop high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications. This technology will enable the warfighter to detect and track low radar cross-section targets at greater ranges, improve situational awareness, and enable development of compact affordable transmitters for smaller platforms such as advanced unmanned air vehicles.		
	- (U) Demonstrate 10-watt, 7-12 gigahertz amplifiers for multifunction phased array radars having 25% range improvement without increasing aircraft power requirements.		
	- (U) Demonstrate and transition the first low-cost, 35 gigahertz high-power transmit amplifiers to enable all-weather, precision guided weapons which will improve the range and probability of kill of advanced smart missiles.		
	- (U) Fabricate and test advanced transistors for microwave amplifiers that produce higher power (via improved heat dissipation) for compact, reliable, and affordable radio frequency sensors.		
- (U) \$1,780	Develop high-operating-temperature, military-essential, solid state microwave transmitters used in ground-based and airborne radar applications. This technology allows compact transmitters to be located in remote areas of the platform for increased sensor coverage.		
	- (U) Develop high yield process technologies to enable high-operating-temperature microwave transistors that will improve the reliability and lower the life cycle costs of air defense radars.		
	- (U) Fabricate and evaluate high-operating-temperature integrated circuits to demonstrate potential for application to advanced EW and radar applications with reduced cooling requirements.		

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

## February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

**0602204F Aerospace Avionics**

## PROJECT

2002

- |               |                                                                                                                                                                                                                                                                                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) \$1,417 | Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for electronic warfare (EW), radar, and communications applications which will result in modular, very compact and affordable microwave and millimeter wave transmitters. |
| - (U) \$1,646 | <ul style="list-style-type: none"> <li>- (U) Fabricate and test components for advanced microwave tubes for very high-power and wide-bandwidth radar and EW transmitters at one-fifth the size.</li> </ul>                                                                        |
|               | Develop military unique millimeter wave integrated circuits for terminal guidance and communications systems with reduced size and weight, thereby, enabling the inclusion of these sensors on very small platforms.                                                              |
| - (U) \$9,613 | <ul style="list-style-type: none"> <li>- (U) Fabricate and evaluate millimeter wave integrated circuit signal control components to improve the performance and reliability of terminal guidance radars with enhanced target tracking and detection capabilities.</li> </ul>      |
|               | Total                                                                                                                                                                                                                                                                             |

(U) FY 1999 (\$ in Thousands):

- |               |                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) \$2,746 | Develop military essential mixed-mode (e.g., high-power/low-noise, microwave/digital, electronic/electro-optical, etc.) multi-function components for radar and EW receivers and for digital phased array radars. Application of this compact and more flexible sensor technology will improve warfighter situational awareness, enhance defense suppression, and improve precision weapon delivery. |
|               | - (U) Demonstrate and refine advanced analytical methods for evaluating mixed-mode integrated components to reduce non-recurring engineering costs for systems such as high performance radar and EW receivers.                                                                                                                                                                                      |
|               | - (U) Demonstrate miniature digital receivers and direct digital waveform transmitters which will reduce the weight and volume of airborne receiver systems and enhance situational awareness by increasing target detection/tracking sensitivity.                                                                                                                                                   |
| - (U) \$2,506 | Develop high-power (1 to 100 watts), military unique, solid state transmitters for radar and communications applications. This technology will enable the warfighter to detect and track low radar cross-section targets at greater ranges, improve situational awareness, and enable development of compact affordable transmitters for smaller platforms such as advanced unmanned air vehicles.   |
|               | - (U) Demonstrate 5-watt output power, 35 gigahertz high-power transmit amplifiers for precision-guided weapons which will improve the range and probability of kill of advanced smart missiles.                                                                                                                                                                                                     |
|               | - (U) Demonstrate advanced transistors and fabrication techniques for microwave amplifiers that have improved power dissipation and enhanced reliability for use in compact and affordable radio frequency sensors.                                                                                                                                                                                  |

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	2002	
- (U) \$2,833	Develop high yield process technologies to enable high-operating-temperature, military-essential, solid state microwave transmitters used in ground-based and airborne radar applications. This technology allows compact transmitters to be located in remote areas of the platform for increased sensor coverage.		
	<ul style="list-style-type: none"><li>- (U) Demonstrate candidate materials that will improve the reliability of microwave transistors used in ground and air defense radars which have increased reliability and lower life cycle costs.</li><li>- (U) Demonstrate integrated circuits for reliable, high-power operation of advanced electronic warfare and radar applications which will increase the range for detecting targets and jamming threats.</li><li>- (U) Demonstrate high-power internally matched transistors that will allow replacement of vacuum tube transmitters in high-power radar, improving mobility and lowering support costs.</li></ul>		
- (U) \$1,256	Develop military unique, very high-power (100 to 1,000 watts) vacuum electronics devices and components for electronic warfare, radar, and communications applications which will result in modular, very compact and affordable microwave and millimeter wave transmitters.		
	<ul style="list-style-type: none"><li>- (U) Demonstrate components for advanced microwave tubes resulting in increased power and efficiency and reduced size and cost for compact radar and electronic warfare transmitters.</li></ul>		
- (U) \$9,341	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602204F Aerospace Avionics

2002

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	8,784	10,046	9,529	Cost
	8,489	9,613	9,341	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602204F Aerospace Avionics

PROJECT

2003

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2003 Avionics System Design Technology		8,233	6,317	9,498	10,070	10,459	10,751	11,029	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops advanced avionics technology for digital processing, software tools and techniques, and systems architectures. Develops new concepts, demonstrates feasibility, and advances technology for avionics system needs. Advances technology for avionics displays, digital processing hardware, sensor integration, and real-time distributed software to improve weapon system performance and avionics availability. Advances in these avionics technologies will multiply weapon systems effectiveness, enhance reliability, and reduce life cycle costs.

## (U) FY 1997 (\$ in Thousands):

- (U) \$1,303 Develop advanced technologies to increase functionality and flexibility of embedded, real-time airborne data processing.
- (U) Developed techniques and tools necessary for translating old computer code from existing avionics processors into advanced commercial-based avionics processors.
- (U) Developed technology for quantifying trade offs between performance and costs for distributed, multi-processor avionics software.
- (U) Developed and define a maturation strategy for incorporating Ada 9X features in a distributed, multi-processor avionics application.
- (U) \$2,491 Develop advanced integration, fusion, and data management technologies that enable increased exploitation of avionics assets to provide for more cost-effective system solutions.
- (U) Developed and tested an avionics brassboard of a scaleable, coherent, interface network that will increase avionics reliability and improve real-time performance.
- (U) Developed distributed, fault-tolerant extensions to basic object-oriented data base management system.
- (U) Analyzed performance and environmental requirements of targeted aging platforms; selected commercial-off-the-shelf candidate for demonstration of cost-effective upgrade capability.
- (U) \$2,433 Develop advanced machine intelligence technologies to provide a capability for improved communications, recognition, understanding of sensor data, and pilot aids.
- (U) Develop insertion concepts for development of avionics breadboards which are compatible with commercial personal computer memory card standards.
- (U) Design dynamic, real-time scheduling algorithms to improve the correlation of sensors.
- (U) Continue evaluation of associative control process technology for application to avionics.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602204F Aerospace Avionics

PROJECT

2003

- (U) \$2,006

Develop affordable, supportable, producible high definition/resolution displays with all-digital interfaces, that are readable in sunlight, and that are highly reliable (>10,000 hours mean time between failure).

- (U) Continued investigation of technology to increase the optical efficiency of active matrix liquid crystal displays to facilitate dissemination of situational data to the pilot.

- (U) Developed field-emissive display for high-brightness, sunlight-readable cockpit flight instruments.

- (U) \$8,233

Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$1,962

Develop avionics software engineering technologies to improve reliability, quality, and supportability of both existing and next-generation weapon systems software. Successful re-engineering of existing software will dramatically improve the cost of modernizing aging avionics.

- (U) Develop an automated method for translating embedded computer software from obsolete avionics processors to advanced commercial-based processors with no loss of performance or capability.

- (U) Demonstrate advanced techniques for debugging Air Force application specific avionics software.

- (U) Demonstrate automated software testing capability for verifying accuracy of text and dynamic symbology in smart avionics displays.

- (U) Develop initial capability for in-flight self-testing and self-correcting mission-critical avionics software.

Develop advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets.

- (U) \$1,732

- (U) Demonstrate ability to update inertial navigation system using old Global Positioning System (GPS) data to project position when current GPS data is not available.

- (U) Demonstrate real-time, object-oriented database management system for increased situational awareness.

- (U) Continue development and application of the associative control process (reinforcement learning) technology for combat information fusion.

- (U) \$2,623 Develop advanced integration technology and evaluate the feasibility of integrating commercial-off-the-shelf components for affordable avionics modernization.

- (U) Develop methods for packaging commercial-off-the-shelf products into reliable, maintainable avionics hardware modules.

- (U) Demonstrate utility of personnel computer processor/memory card technology for upgrading existing fighter aircraft processors.

- (U) \$6,317

Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	2003	
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,504	Develop software engineering technologies to promote assured performance of complex existing and next-generation air and space platform software. These technologies are critical to ensuring the affordability of future weapon systems.		
-	(U) Demonstrate automated means to ensure correctness of mission-critical software that drives complex graphical displays (e.g. cockpit displays, command center consoles, etc.).		
-	(U) Develop capability to perform in-flight self-correcting and self-adapting functions for mission-critical weapon and information systems.		
-	(U) Develop new techniques for scaleable software architectures to rapidly and cost-effectively incorporate new functions.		
- (U) \$3,429	Develop advanced machine intelligence technologies to provide a capability for enhanced management of critical on-board sensors and detection/recognition of targets.		
-	(U) Demonstrate an enhanced, distributed, real-time embedded avionics object-oriented database management system conforming to multi-level security standards.		
-	(U) Demonstrate advanced, multiple target identification capability based on integration of information from disparate sources.		
-	(U) Demonstrate advanced sensor manager for tactical air-to-air and air-to-ground surveillance.		
-	(U) Develop efficient target recognition techniques based on machine intelligence research.		
-	(U) Continue development and application of associative control process (reinforcement learning) technology for combat information fusion.		
- (U) \$2,565	Develop and demonstrate avionics integration technologies that allows rapid re-allocation of avionics hardware to meet changing operational requirements. These technologies dramatically reduce warfighter timelines for interoperability and adaptability in changing threat environments.		
-	(U) Develop technology that merges high-level design information and hardware algorithms to result in reconfigurable, integrated avionics modules that provide weapon and information systems with unprecedented mission adaptability.		
- (U) \$9,498	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
2 - Applied Research	0602204F Aerospace Avionics	2003																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="0"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>8,242</td> <td>9,301</td> <td>9,689</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>8,233</td> <td>6,317</td> <td>9,498</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	8,242	9,301	9,689	Cost	(U) Current Budget Submit/FY 1999 PB	8,233	6,317	9,498	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	8,242	9,301	9,689	Cost														
(U) Current Budget Submit/FY 1999 PB	8,233	6,317	9,498	Cont														
<p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p>																		
<p>Schedule: Not Applicable.</p>																		
<p>Technical: Not Applicable.</p>																		
<p>(U) C. <u>Other Program Funding Summary:</u></p>																		
<p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0603253F, Advanced Avionics Integration.</li> <li>- (U) PE 0602301E, Intelligence System Program.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>																		
<p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>																		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE		February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT			
2 - Applied Research		0602204F Aerospace Avionics								6095			
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost			
6095	Information Fusion Technology	9,771	7,486	11,606	12,729	13,604	14,368	15,120	Continuing	Continuing			
<p>(U) <u>A. Mission Description and Budget Item Justification:</u> Develops the baseline technologies required to perform management and fusion of on-board sensor information for timely, comprehensive situation awareness, automatic target recognition, integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that aid in precisely locating, identifying, and targeting airborne and surface targets (with emphasis on reduced signature targets and targets of opportunity) to enable new covert tactics for successful accomplishments of air-to-air and air-to-surface strike scenarios</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$979 Develop reference sensors, system integration, and estimation technology to generate a common precision reference to enable high-payoff multiple platform operations through sharing of sensor data.</li> <li>- (U) \$399 Develop advanced reference and navigation algorithms to enable multiple platforms to share information in a battle area.</li> <li>- (U) \$848 Develop advanced solid state miniature inertial sensor technology to increase the reliability of inertial sensors required for aircraft and to reduce overall avionics size, weight, power, and cost.</li> <li>- (U) \$895 Fabricated and tested second iteration of a packaged, navigation-grade, micro-machined silicon accelerometer for highly reliable, all-solid state inertial guidance and navigation systems.</li> <li>- (U) \$379 Develop technology for reduced jamming vulnerability and increased precision targeting and strike accuracy of Global Positioning System (GPS) data and to exploit the benefits of GPS data to improve offensive and defensive combat capabilities at reduced cost.</li> <li>- (U) \$379 Tested signal acquisition techniques to improve the jam resistance of GPS data for aircraft navigation and reference systems.</li> <li>- (U) \$379 Develop technology for low-observable, wideband, multi-function antennas for communications, navigation, and identification functions to reduce the number of antennas required and to increase weapon systems survivability.</li> <li>- (U) \$379 Completed fabrication and laboratory evaluation of a broadband wideband digital antenna electronics unit providing small, low-cost, low-loss, beam forming/null-steering communication, navigation, and identification antennas.</li> <li>- (U) \$379 Develop advanced aircraft air engagement technologies for detection and tracking of conventional and low cross section threats to increase weapon system lethality and survivability.</li> <li>- (U) \$379 Evaluated operational payoff of innovative tracking schemes by using real flight data in ground tests of algorithms.</li> </ul>													

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	6095	
- (U) \$982	Develop sensor management technologies and innovative deployment tactics to increase air combat situational awareness, increase range, and improve high-confidence target identification.		
	<ul style="list-style-type: none"><li>- (U) Ground-tested and evaluated algorithms which fuse all available radar data for a more comprehensive target picture.</li><li>- (U) Evaluated sensor management technologies capable of integrating ownship sensor data and off-board data to improve situational awareness.</li><li>- (U) Evaluated candidate technologies that allow aircraft in the same flight to share information to promote commonality of fire control functions across various platforms.</li></ul>		
- (U) \$220	Develop innovative surface strike targeting techniques using all available (on-board and off-board) threat targeting information.		
- (U) \$1,520	<ul style="list-style-type: none"><li>- (U) Designed targeting scheme that uses off-board information to aid in development of the fire control solution passed to the weapon.</li></ul>		
	Develop advanced automatic target recognition algorithm techniques.		
	<ul style="list-style-type: none"><li>- (U) Integrated advanced feature extraction techniques to evaluate performance improvement in automatic target recognition.</li><li>- (U) Evaluated performance of automatic target recognition using advanced thermal invariance algorithms.</li><li>- (U) Demonstrated feasibility of multispectral infrared (IR) fusion of thermal, spatial, and motion features of threat aircraft.</li></ul>		
- (U) \$1,061	Develop advanced synthetic signature and scene generation capability to train automatic target recognition algorithms.		
	<ul style="list-style-type: none"><li>- (U) Integrated advanced IR target generation with scene generation capability.</li><li>- (U) Demonstrated high-fidelity, high-speed synthetic aperture radar signature and scene prediction.</li></ul>		
- (U) \$919	Develop analytical and empirical automatic target recognition modeling techniques to determine performance boundaries of automatic target recognition.		
	<ul style="list-style-type: none"><li>- (U) Used real and synthetic data to evaluate performance of automatic target recognition algorithm against multiple target types.</li></ul>		
- (U) \$1,569	Develop robust, ultra-high-range radar algorithms for both air-to-air and air-to-ground applications.		
	<ul style="list-style-type: none"><li>- (U) Demonstrated advanced, robust, ultra high-range radar algorithms in a laboratory environment.</li></ul>		
- (U) \$9,771	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,218	Develop and evaluate multisensor management technologies to optimize search techniques, increase air combat situational awareness, increase detection ranges, allow high-confidence target identification, and enhance surface strike applications.		
	<ul style="list-style-type: none"><li>- (U) Complete evaluation of sensor management technologies capable of integrating ownship sensor data (offensive and defensive sensors) and off-board data to increase air combat situational awareness and provide all aspect fire control capability.</li><li>- (U) Refine targeting scheme for utilizing off-board information for final weapon solution.</li></ul>		

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Exhibit R-2 (PE 0602204F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	6095	
- (U) \$2,496	Demonstrate rapid evaluation of multi-sensor system concepts to support all-aspect fire control, target tracking, and situation awareness.		
- (U) \$554	<ul style="list-style-type: none"><li>(U) Complete medium fidelity sensor models and preliminary performance measurement capabilities for multi-sensor testbed. Archive limited sets of actual sensor data for fusion concept evaluation.</li></ul> Apply emerging open software architecture standards and practices to the development and evaluation of real-time, on-board, adaptive information fusion systems for reduced targeting errors and enhanced situation awareness.		
- (U) \$1,220	<ul style="list-style-type: none"><li>(U) Design an architectural framework describing the functions, interfaces, and measures of performance for advanced information fusion systems.</li><li>(U) Initiate development of avionics fusion architecture components in conjunction with fusion researchers from the Department of Defense, industry, and academia.</li><li>(U) Establish baseline performance characteristics for avionics fusion applications and quantify the effects of reference system-related errors on fusion algorithms.</li></ul> Develop low-cost techniques using on-board sensors for cooperative air-to-ground identification of friendly forces to reduce fratricide and increase mission effectiveness.		
- (U) \$998	<ul style="list-style-type: none"><li>(U) Develop techniques and radar and infrared technologies necessary for existing aircraft to identify friendly ground forces.</li></ul> Develop advanced automatic target recognition (ATR) techniques.		
	<ul style="list-style-type: none"><li>(U) Verify feasibility of integrating advanced synthetic aperture radar and passive radio frequency target generation capability.</li><li>(U) Extract exploitable 'signature fingerprints' from high-range resolution and synthetic aperture radar data for use in target identification/synthetic model development.</li></ul>		
	<ul style="list-style-type: none"><li>(U) Continue integration of advanced radar feature extraction techniques to evaluate performance improvement in radar ATR versus current approaches.</li><li>(U) Evaluate performance enhancement of infrared (IR) ATRs using advanced thermal invariance algorithms.</li><li>(U) Begin development of ATR algorithms which employ computational learning and invariant IR and radio frequency features to enhance the performance of radar, IR, and multispectral ATR systems.</li></ul>		
- (U) \$7,486	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,756	Develop, evaluate, and demonstrate air-to-air single and multisensor tracking, sensor management, fire control, situation awareness, and identification algorithms to dramatically improve air combat capability.		
	<ul style="list-style-type: none"><li>(U) Develop advanced sensor fusion technologies for fighter aircraft to enable detection, tracking, and engagement of low-observable aircraft.</li></ul>		

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Exhibit R-2 (PE 0602204F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	6095	
- (U) \$5,062	Develop, evaluate, and demonstrate air-to-ground single and multisensor tracking, sensor management, fire control, situation awareness, and identification algorithms to dramatically improve reconnaissance, surveillance, and strike operations.		
	- (U) Expand the multi-sensor fusion testbed capability by adding additional truth targets, additional sensor models, limited man-in-the-loop capability, and enhanced measures of performance.		
	- (U) Update and refine open system avionics architecture for real-time, embedded, adaptive information fusion systems.		
	- (U) Provide detailed design of an architectural framework describing the functions, interfaces, and measures of performance for advanced information fusion systems.		
	- (U) Continue to evaluate avionics information fusion architecture concepts in conjunction with fusion researchers from the Department of Defense, industry, and academia.		
	- (U) Continue development of techniques and supporting radar and infrared technologies necessary for existing aircraft to identify friendly ground forces.		
- (U) \$2,772	Develop, evaluate, and demonstrate feasibility of single and multisensor automatic target recognition (ATR) algorithms to dramatically improve capability to recognize hostile ground forces.		
	- (U) Demonstrate integration of advanced synthetic aperture radar and passive radio frequency (RF) target generation capability.		
	- (U) Demonstrate extraction of exploitable 'signature fingerprints' from high range resolution and synthetic aperture radar data for use in target identification.		
	- (U) Continue development of ATR algorithms which employ computational learning and invariant infrared and RF features to enhance the performance of radar, infrared, and multispectral ATR systems.		
- (U) \$1,216	Develop and demonstrate enabling technologies for long-range, high-altitude air and space vehicles.		
	- (U) Identify high-risk, high impact technologies needed to provide extremely high-altitude, long-range targeting and attack capabilities for space planes.		
- (U) \$800	Develop precision time, position, and velocity sensors for generating a common precision reference and to enable multiple platforms to share sensor data.		
	- (U) Develop and evaluate techniques for optimizing inertial sensors for integration with Global Positioning System (GPS) and inertial systems.		
	- (U) Design avionics fusion algorithms to quantify and improve the effects of reference-system-related errors.		
- (U) \$11,606	Total		

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Exhibit R-2 (PE 0602204F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	6095	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	10,354	11,038	11,534
	9,771	7,486	11,606
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to increased emphasis on Information Fusion technologies within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0603203F, Advanced Avionics Integration.			
- (U) PE 0602602F, Conventional Munitions.			
- (U) PE 0603270F, Electronic Warfare Technology.			
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies			
- (U) PE 0603762E, Sensor and Guidance Technology			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602204F Aerospace Avionics

6096

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
6096 Microelectronics Technology	7,586	9,273	9,475	8,906	9,874	9,679	9,898	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project focuses on military unique, avionics aspects of microelectronics such as high-speed devices and circuits; packaging and power distribution; design tools; and hardware design languages. The warfighter requirements for technology developments are based on Air Force and other DoD weapon systems needs in the areas of radar, communications, electronic warfare, navigation, and smart weapons applications. Paramount to success is the development of high-speed analog-to-digital converter circuits, design, packaging, and power management support technologies that provide for the utilization of commercial-off-the-shelf products and military essential avionics devices and circuits. Computer-aided engineering technology is key to addressing the low-cost, very high performance, low power, tough environmental, multi-organization development, and high complexity challenges of our warfighting electronics. The developed technology is unavailable through commercial sources.

(U) **FY 1997 (\$ in Thousands):**

- (U) \$2,892 Develop advanced integrated circuits, including analog to digital converter circuits, for military radio frequency (RF) and digital support electronics.
- (U) Optimized devices and fabrication processes for a transceiver chip set to improve performance and reliability of digital support electronics.
- (U) Fabricated and tested devices and integrated circuits for direct X-band analog-to-digital conversion to improve reliability and performance of radar support electronics.
- (U) Designed and developed high-speed circuits to augment the capability of commercial circuits for processing complex RF signals. Develop surface protective coatings, distributed power management, microprocessors, and digital engine control technology to improve the reliability of electronic subsystems.
- (U) \$1,528 Evaluated advanced packaging techniques for the direct X-band analog-to-digital conversion to improve reliability and performance of radar support electronics.
- (U) Designed and developed direct mount electronic engine control circuits that can withstand very high temperatures.
- (U) Completed evaluation of an advanced surface-protective coating process for integrated circuits.
- (U) \$1,574 Develop and integrate advanced design tools into a commercial software environment for affordable model year upgrades.
- (U) Demonstrated a rapid design approach to interface avionics sensors with the processor.
- (U) Developed a reuse library for aircraft electronics integrated circuit designs.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	6096	
- (U) \$1,592	Develop hardware design language technology for more effective control of obsolete parts and logistics costs for existing weapon systems.		
- (U) \$7,586	- (U) Completed the digital hardware design language validation suite.		
	- (U) Developed methods for mixing analog and digital models in the same validation suite.		
	- (U) Continued development of reengineering support tools and electronics libraries for aging aircraft electronics suites.		
	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,616	Develop advanced high-speed devices and fabrication processes for digital integrated circuits to allow high-speed military sensors to interface with slower commercial processing components, thereby, eliminating bulky, costly, and temperature-sensitive down-conversion electronics. These technologies include very high-speed analog-to-digital converter circuits, digital radio frequency memory chips, etc.		
	- (U) Demonstrate high-speed devices and fabrication processes for a transceiver chip set to improve performance and reliability of high dynamic range, high sensitivity receivers while achieving a factor of fifty reduction in size.		
	- (U) Fabricate and test devices and integrated circuits for greater than ten gigahertz analog-to-digital conversion for radar and electronic warfare sensors with high sensitivity receivers.		
- (U) \$2,616	Develop surface protective coatings, distributed power management, and packaging technologies for high performance digital integrated circuits to improve reliability and lower the cost of components that are required to operate in harsh military environments.		
	- (U) Develop high frequency, 100 megahertz power switching devices for modular avionics sensors to provide more efficient power conversion technology for advanced sensors such as phased array antennas and electronic warfare transmitters and receivers.		
- (U) \$1,744	Develop and integrate advanced design tools into a commercial software environment for affordable model year upgrades.		
	- (U) Develop and demonstrate a second, more capable version of the software tools for on-the-fly reconfigurable computing for flexible mission profiles.		
	- (U) Demonstrate utility of software tools for re-engineering/replacing electronic components that are obsolete or no longer manufactured.		
	- (U) Complete development of extensive, portable library of reusable military integrated circuit designs to speed insertion of advanced technology.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602204F Aerospace Avionics

6096

- (U) \$2,297

Develop next-generation hardware design languages (HDLs) to enable more effective interchange of replacement part design information, better control of obsolete parts, and reduced logistics support costs.

- (U) Complete support documentation to promote digital and analog HDLs as industry standards.

- (U) Complete development of digital HDL training material and validation suite; transition to users (e.g., air logistics centers and system program offices).

- (U) Develop an improved version of the software tools for using both analog and digital HDLs for circuits with analog and digital components.

- (U) \$9,273

Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$2,733 Develop advanced high-speed devices and fabrication processes for digital integrated circuits to allow high-speed military sensors to interface with slower commercial processing components, thereby, eliminating bulky, costly, and temperature-sensitive down-conversion electronics. These technologies include very high-speed analog-to-digital converter circuits, digital radio frequency memory chips, etc.

- (U) Continue to demonstrate high-speed devices and fabrication processes for a transceiver chip set to improve performance and reliability of high dynamic range, high sensitivity receivers while achieving a factor of fifty reduction in size.

- (U) Augment analog-to-digital conversion circuits to enable more extensive use of commercial-off-the-shelf components in radar, electronic warfare, and communications/navigation/identification sensors, thereby, reducing cost, weight, and volume.

- (U) \$1,809 Develop surface protective coatings and packaging technologies for high performance, mixed analog/digital microwave circuits to improve reliability and lower the cost of components that must operate in harsh military environments.

- (U) Develop advanced packaging and interconnect processes applicable to advanced sensors such as phased array antennas and electronic warfare transmitters and receivers.

- (U) \$2,212 Develop advanced design tools to reduce the cost and time required to create complex Air Force electronic systems.

- (U) Assess and refine tools for automating the design of next-generation electronic "systems-on-a-chip".

- (U) Integrate algorithms with reconfigurable computing and high-level design automation tools for faster handling of battlefield information.

- (U) \$2,721 Develop next-generation design languages to support the complexity in implementing the Air Force's "system of systems" vision.

- (U) Develop extensions to the industry standard hardware description language to support modeling of complex information networks.

- (U) Develop design language tools for capturing complex military information system needs and constraints.

- (U) \$9,475

Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
2 - Applied Research	0602204F Aerospace Avionics	February 1998	6096
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	7,909	9,689	9,666
	7,586	9,273	9,475
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.			
- (U) PE 0602702F, Command, Control and Communications.			
- (U) PE 0602705A, Electronics and Electronic Devices.			
- (U) PE 0602234N, Materials, Electronics and Computers.			
- (U) PE 0602712E, Materials and Electronics.			
- (U) PE 0603739E, Manufacturing Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602204F Aerospace Avionics

PROJECT

7622

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
7622 Radio Frequency Sensor Technology		7,953	7,632	9,222	9,782	10,161	10,429	10,701	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Determines feasibility of technology for reliable, all-weather, reconnaissance and precision strike radio frequency sensors and information transfer systems. Emphasis is on: acquisition of surface and airborne targets with difficult to detect signatures due to reduced radar cross sections, concealment and camouflage measures, severe clutter, and/or heavy jamming; and satisfying the growing need to transmit data between aircraft with high integrity, low probability of detection, and high jam resistance. Assured low probability of detection communications are required to reduce aircraft physical and electromagnetic vulnerability and provide major improvements in strike effectiveness by eliminating the requirement for "no communications" operations.

## (U) FY 1997 (\$ in Thousands):

- (U) \$1,130 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, that also explore reducing life cycle cost.
  - (U) Developed concept for an integrated analog/digital radio frequency system to reduce receiver hardware specifications and field maintenance.
- (U) \$2,229 Develop tools and techniques that significantly reduce the cost and time to develop complex, synthetic, airborne radar environments.
  - (U) Developed user-friendly, automated, object-oriented programming system to allow ground controllers to maneuver synthetic aperture radar to penetrate foliage and mitigate hostile electromagnetic environments.
- (U) \$2,267 Develop integrated radar/targeting engineering analysis tools to evaluate sensor targeting errors for front-line fighter aircraft.
  - (U) Established baseline radar analysis library with emphasis on user-friendly, automated, object-oriented and reusable software.
- (U) \$253 Develop two-dimensional radar imaging technology for enhanced all aspect air-to-air target identification capability.
  - (U) Developed two-dimensional imaging technology to enhance front-line fighter first-look, first-kill capability.
- (U) \$648 Develop technology to improve communication system electromagnetic interference rejection which in turn will provide the pilot more reliable communications in the combat environment.
  - (U) Completed development and evaluation of low-cost techniques to reduce radiated co-site interference for assured communications.
- (U) \$747 Develop technology for short-range, low probability of detection, jam-resistant capabilities for voice communication and low-data-rate information exchange to eliminate the need for "comm out" operations and to increase survivability.
  - (U) Completed initial breadboard and laboratory tested joint Army/Air Force ultraviolet, non-line-of-site communications concept which will enable effective communications during nap-of-the-earth flight operations.
  - (U) Developed preliminary design and assessed radiated co-site interference for use of non-traditional communications capability.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		February 1998
PE NUMBER AND TITLE		PROJECT 7622
2 - Applied Research		0602204F Aerospace Avionics
- (U) \$679	Develop technology for automation of cockpit communications to reduce pilot workload and increase the availability of communications during combat operations.	
- (U) \$7,953	- (U) Completed design and began fabrication of a brassboard to demonstrate a voice-actuated expert system that will control cockpit communications.	
- (U) \$7,953	Total	
(U) FY 1998 (\$ in Thousands):		
- (U) \$3,025	Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, to improve performance and also reduce life cycle cost.	
- (U) \$2,802	- (U) Refine integrated radio frequency (RF) techniques to improve weapon systems performance, reduce RF system operating costs, and increase situational awareness in some operating environments.	
- (U) \$2,802	- (U) Develop limited processing improvements of adaptive algorithms for terrain scattered interference cancellation, radome reflection lobe cancellation, and side/main lobe cancellation in advanced fighter aircraft radars.	
- (U) \$2,802	- (U) Develop limited set of radar engineering analysis tools to evaluate sources of sensor targeting errors in front-line fighter aircraft.	
- (U) \$2,802	Develop advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage.	
- (U) \$2,802	- (U) Develop targeting scenes, using improved analytical clutter generation, for limited evaluation of advanced synthetic aperture radar (SAR) sensors.	
- (U) \$1,805	- (U) Develop limited capability to analyze advanced SAR sensors and predict their performance characteristics given particular system parameters, processing, target aspects, motion compensation systems, and targeting scenarios.	
- (U) \$1,805	Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness.	
- (U) \$1,805	- (U) Complete laboratory test of joint Army/Air Force ultraviolet, non-line-of-sight, communications concept which will enable effective communications during nap of the earth flight operations.	
- (U) \$1,805	- (U) Design a hybrid radio frequency/electro-optical interference rejection filter to provide a three orders of magnitude increase in rejection of interfering signals while reducing size, weight, power, and cost of airborne communication receivers.	
- (U) \$1,805	- (U) Continue fabrication and begin integration of an expert system brassboard that manages communication systems for assured communications.	
- (U) \$7,632	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
2 - Applied Research		0602204F Aerospace Avionics	7622
<p>(U) FY 1999 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$3,621 Develop advanced microwave sensor technology for air-to-air radar and target detection, including electronic protection, multi-dimensional image processing, and adaptive algorithms, to improve performance and also reduce life cycle cost.</li> <li>- (U) Perform laboratory testing of integrated radio frequency (RF) techniques to improve weapon systems performance, reduce RF system operating costs, and increase situational awareness in all operating environments.</li> <li>- (U) Continue to develop limited processing improvements of adaptive algorithm for terrain scattered interference cancellation, radome reflection lobe cancellation, and side/main lobe cancellation in advanced fighter aircraft.</li> <li>- (U) Continue to develop limited set of radar engineering analysis tools to evaluate sources of sensor targeting errors in front-line fighter aircraft.</li> <li>- (U) \$3,186 Develop advanced airborne sensors for air-to-ground targeting and attack with robust performance in adverse weather, severe jamming, natural clutter, or concealment by foliage or camouflage.</li> <li>- (U) Continue to develop targeting scenes, using improved analytical clutter generation, for use in evaluation of advanced synthetic aperture radar (SAR) sensors.</li> <li>- (U) Continue development of limited analytical tools to predict the performance characteristics of advanced SAR sensors given particular system parameters, target aspects, motion compensation systems, and targeting scenarios.</li> <li>- (U) \$2,415 Develop technology for information transmission between airborne vehicles and cooperating assets with high fidelity, low probability of detection, and high jam resistance to improve strike effectiveness.</li> <li>- (U) Complete preliminary design of a hybrid radio frequency/electro-optical interference rejection filter to provide a three orders of magnitude increase in rejection of interfering signals while reducing size, weight, power, and cost of airborne communication receivers.</li> <li>- (U) Complete integration of an expert system brassboard that manages communication systems for assured communications.</li> <li>- (U) \$9,222 Total</li> </ul>			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602204F Aerospace Avionics	7622	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	7,976	8,016	9,407
	7,953	7,632	9,222
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.			
- (U) PE 0603253F, Advanced Avionics Integration.			
- (U) PE 0602782A, Command, Control and Communications (C3) Technology.			
- (U) PE 0602232N, Navy C3 Technology.			
- (U) PE 060379N, Advanced Technology Demonstration Program.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602269F Hypersonic Technology Program								1025	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
1025 Hypersonic Technology		9,986	9,305	16,649	16,577	16,396	16,287	16,352	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification:** This Applied Research program develops advanced hypersonic technologies and will provide revolutionary technology options to satisfy future Air Force needs such as future hypersonic weapons and space launch concepts. This effort captures applicable hypersonic technologies from the National Aero-Space Plane (NASP) program. This program will focus on hydrocarbon fueled hypersonic vehicle technologies and demonstrate their feasibility. Technologies developed under this program will be dual-use and applicable to both DoD and NASA requirements. Planned efforts include analyses, hypersonic materials/structures, airbreathing propulsion, hydrocarbon fuels, and integrated technology test demonstrations. Development of hypersonic technologies was previously conducted under the National Aero-Space Plane (NASP) program and the Hypersonic Systems Technology Program (HySTP). In FY 1995, the Air Force canceled HySTP and refocused efforts into a hypersonic technology initiative. This required a major restructure of the program requiring Congressional approval. Note: The FY 1999 and out increase reflects additional emphasis on development of the hypersonic propulsion system.

**(U) FY 1997 (\$ in Thousands):**

- (U) 8,863 Designed, developed, and tested propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
- (U) Completed investigation of advanced injection/flareholding technologies to optimize scramjet performance.
- (U) Continued detailed design and fabrication of components for a scramjet engine (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.
- (U) Determined foreign scramjet hardware performance potential through detailed analysis and test, and evaluated potential suitability to U.S. scramjets.
- (U) Demonstrated endothermic fuel concepts to extend hydrocarbon-fueled scramjet capability from Mach 4-8 to Mach 10.

- (U) \$239 Designed, developed, and tested advanced high-temperature, high-strength materials and structures for hypersonic applications.

- (U) \$263 Performed detailed characterization and testing of selected high-temperature, lightweight materials for the internal sections of hypersonic propulsion engines.

- (U) \$263 Developed technologies for instrumentation and test in realistic hypersonic conditions.

- (U) Fabricated and experimentally verified hypersonic test instrumentation that can withstand and accurately sense internal flow conditions (e.g., temperature, pressure, heat flux, etc.) without disturbing airflow or engine operating conditions.

- (U) \$473 Developed and extended computational technologies from low-speed and supersonic flight to the hypersonic environment.

- (U) Developed initial concepts to extend interdisciplinary computational fluid dynamics and vehicle thermal management modeling for an integrated design methodology to create an affordable hypersonic design.

Project 1025

Exhibit R-2 (PE 0602269F)

Page 1 of 4 Pages

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602269F Hypersonic Technology Program	1025	
- (U) \$148	Conducted feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications which will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.		
- (U)	Conducted mission analyses to characterize user requirements and technology maturity.		
- (U)	Conducted detailed missile designs to guide technology requirements definition and development.		
- (U) \$9,986	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$8,098	Design, develop, and test propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.		
- (U)	Continue detailed design and initiate fabrication of test components for a scramjet engine (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.		
- (U)	Complete reverse engineering and component/subscale testing of foreign scramjet hardware to determine foreign design methodology. Determine need for further testing at larger scale.		
- (U)	Complete demonstration of endothermic fuel concepts to increase performance and alleviate flowpath temperatures in Mach 4-8 engine.		
- (U) \$471	Design, develop, and test advanced high-temperature, high-strength materials and structures for hypersonic applications.		
- (U)	Complete detailed characterization and testing of first set of down-selected high-temperature, lightweight materials for the internal sections of hypersonic propulsion engines.		
- (U) \$284	Develop technologies for instrumentation and test in realistic hypersonic conditions.		
- (U)	Continue fabrication and testing of hypersonic test instrumentation that can withstand and accurately sense internal flow conditions (e.g., temperature, pressure, heat flux, etc.) without disturbing airflow or engine operating conditions.		
- (U) \$310	Develop and extend computational technologies from low-speed and supersonic flight to the hypersonic environment.		
- (U)	Complete refinement of concepts to extend interdisciplinary computational fluid dynamics and vehicle thermal management modeling for an integrated design methodology to create an affordable hypersonic design. Initiate validation of computational methods in instrumented engine flowpath test rigs.		
- (U) \$142	Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.		
- (U)	Continue mission analyses to characterize user requirements and technology maturity.		
- (U)	Refine detailed missile designs to guide inter-disciplinary technology requirements definition and development for integrated hypersonic vehicles.		
- (U) \$9,305	Total		

Project 1025

Page 2 of 4 Pages

Exhibit R-2 (PE 0602269F)

UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602269F Hypersonic Technology Program

PROJECT

1025

(U) FY 1999 (\$ in Thousands):

- (U) \$14,655 Design, develop, and test propulsion components, structures, and integrated propulsion designs for advanced hypersonic propulsion concepts.
- (U) Continue testing of scramjet engine components (e.g., inlet, combustor, and nozzle) capable of demonstrating positive thrust at Mach 4-8 while withstanding the severe internal conditions.
- (U) Initiate detailed design of freejet test engine and initiate fabrication of components.
- (U) Apply endothermic fuel concepts to specific designs of Mach 4-8 engines.
- (U) Design, develop, and test advanced high-temperature, high-strength materials and structures for hypersonic applications.
- (U) Initiate detailed characterization and testing of high-temperature, lightweight materials selected for the internal sections of specific engine configurations.
- (U) Develop technologies for instrumentation and test in realistic hypersonic conditions.
- (U) Apply hypersonic test instrumentation to specific freejet engine configurations and initiate establishment of test instrumentation protocol for freejet testing.
- (U) Develop and extend computational technologies from low-speed and supersonic flight to the hypersonic environment.
- (U) Continue validation of computational methods in instrumented engine flowpath test rigs.
- (U) Conduct feasibility studies, design trades, and simulations to integrate hypersonic technologies into advanced vehicle designs for hypersonic applications that will improve warfighting capability and satisfy the requirements of Global Reach/Global Power.
- (U) Continue mission analyses to characterize user requirements and technology maturity.
- (U) Update detailed missile design to guide inter-disciplinary technology requirements definition and development for integrated hypersonic vehicles.
- (U) \$16,649 Total

Project 1025

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Exhibit R-2 (PE 0602269F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 2 - Applied Research

0602269F Hypersonic Technology Program

1025

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	7,153	9,840	12,984	Cost
(U) Appropriated Value	7,471	9,840		Cont
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-156	-326		
b. SBIR	-162	-209		
c. Omnibus/Other Above Threshold Reprogrammings	-157			
d. Below Threshold Reprogrammings	3,000			
e. Rescissions	-10			
(U) Adjustments to Budget Years Since FY 1998 PB			3,665	
(U) Current Budget Submit/FY 1999 PB	9,986	9,305	16,649	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to increased support of the program schedule.

Schedule: FY 1999 and out increase will return the program to the original demonstration time frame in FY 2003.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602201F, Flight Dynamics.
- (U) PE 0602203F, Aerospace Propulsion
- (U) PE 0603112F, Advanced Materials for Weapon Systems.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 1025

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Exhibit R-2 (PE 0602269F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
2 - Applied Research		0602601F Phillips Laboratory Exploratory Development									
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		138,483	118,266	116,139	131,078	138,457	141,412	143,492	Continuing	Continuing	
1010	Geophysics and Weather Technology	25,322	20,321	15,457	16,349	16,736	16,134	16,609	Continuing	Continuing	
1011	Rocket Propulsion Technology	32,651	29,407	35,542	37,121	38,456	37,733	37,575	Continuing	Continuing	
3326	Lasers and Imaging Technology	16,771	18,485	19,376	20,096	19,924	20,525	20,815	Continuing	Continuing	
5797	Advanced Weapons and Survivability Technology	14,072	14,468	14,645	15,834	16,159	16,779	17,188	Continuing	Continuing	
8809	Space and Missile Technology	49,667	35,585	31,119	41,678	47,182	50,241	51,305	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	
<p><b>(U) A. Mission Description and Budget Item Justification:</b> This is the Applied Research program for space technology, rocket propulsion, and directed energy for the Air Force Research Laboratory. In geophysics, this PE develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. In rocket propulsion, this PE develops technologies for boost and orbit transfer, satellite maneuvering, and tactical/ballistic missile rocket propulsion. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. Advanced weapons examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In space and missiles, this PE develops the following technologies: spacecraft platform (e.g., structures, controls, power, and thermal management); space-based payload (e.g., sensors, satellite communications, and survivable electronics); satellite control (e.g., spacecraft software); ballistic missile/launch vehicle-specific (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging). Note: Congress added \$20.75 million in FY 1997 (Project 1010, \$5.0 million for High Frequency Active Auroral Research Program (HAARP); Project 1011, \$4.75 million for Integrated High Payoff Rocket Propulsion Technology (IHRPRT); and Project 8809, \$6.0 million for Phase III terabit fiber optic technology and \$5.0 million for MightySat) which explains the perceived decrease in FYs 1998 and 1999. Also, the emphasis on Geophysics and Weather Technology has been decreased, while additional emphasis has been placed on space and associated technologies.</p>											

Exhibit R-2 (PE 0602601F)

Page 1 of 38 Pages

(U) **A. Mission Description and Budget Item Justification:** This is the Applied Research program for space technology, rocket propulsion, and directed energy for the Air Force Research Laboratory. In geophysics, this PE develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. In rocket propulsion, this PE develops technologies for boost and orbit transfer, satellite maneuvering, and tactical/ballistic missile rocket propulsion. In lasers, this PE examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques. Advanced weapons examines high power microwave and other unconventional weapon concepts using innovative technologies such as compact toroids. This also provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In space and missiles, this PE develops the following technologies: spacecraft platform (e.g., structures, controls, power, and thermal management); space-based payload (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced spacecraft software); ballistic missile/launch vehicle-specific (e.g., payload/platform/launch vehicle merging). Note: Congress added \$20.75 million in FY 1997 (Project 1010, \$5.0 million for High Frequency Active Auroral Research Program (HAARP); Project 1011, \$4.75 million for Integrated High Payoff Rocket Propulsion Technology (IHPRPT); and Project 8809, \$6.0 million for Phase III terabit fiber optic technology and \$5.0 million for MightySat) which explains the perceived decrease in FYs 1998 and 1999. Also, the emphasis on Geophysics and Weather Technology has been decreased, while additional emphasis has been placed on space and associated technologies.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602601F Phillips Laboratory Exploratory  
Development

## (U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
				Cost
				Cont
(U) Previous President's Budget (FY 1998 PB)	147,712	111,136	123,514	
(U) Appropriated Value	153,507	127,259		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-3,417	-7,390		
b. SBIR	-1,916	-1,603		
c. Omnibus/Other Above Threshold Reprogrammings	-8,228			
d. Below Threshold Reprogrammings	-1,179			
e. Rescissions	-284			
(U) Adjustments to Budget Year Since FY 1998 PB	138,483	118,266	-7,375	
(U) Current Budget Submit/FY 1999 PB			116,139	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

## (U) C. Other Program Funding Summary: Not Applicable.

## (U) D. Schedule Profile: Not Applicable.

UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory

Development

PROJECT

1010

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1010 Geophysics and Weather Technology		25,322	20,321	15,457	16,349	16,736	16,134	16,609	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops the technologies to understand, mitigate, and exploit the effects of the weather and geophysics environments on the design and operation of Air Force systems. This includes defining, modeling, and developing techniques to predict the phenomena of solar and space environments. Models are developed to specify and predict optical and infrared backgrounds and signatures of spacecraft and missiles, as well as techniques to predict when and where ionospheric disturbances will occur. New techniques for measuring, modeling, simulating, and predicting those environmental effects that impact the Air Force mission are investigated.

## (U) FY 1997 (\$ in Thousands):

- (U) \$4,290 Developed techniques to specify and predict the space environment for space system design and operations.
- (U) Designed sensors for detecting/characterizing space particle populations that degrade and destroy satellite electronic components/subsystems, thereby, reducing mission lifetimes and raising system costs.
- (U) Designed optical tracking experiment for solar coronal ejections to provide first-warning of space disturbances that cause spacetrack errors and false launch indicators in infrared (IR) and radar warning sensors.
- (U) Developed/validated a solar flare forecast theory to improve warning notices to spacecraft operators.
- (U) Developed/transitioned solar shock-front transit model to 55<sup>th</sup> Space Weather Squadron (SWS), improving warning capability to one hour.
- (U) \$3,151 Developed atmospheric optical background clutter prediction techniques to support Space Based Infrared System/Defense Surveillance Program (SBIRS/DSP).
- (U) Completed code for use in SBIRS systems engineering phase that specifies the high-altitude atmospheric background clutter environment encountered during endo-atmospheric target intercepts.
- (U) \$2,013 Developed active/passive remote sensing techniques for identifying aircraft and missile target signatures and specifying atmospheric wind profiles needed to improve ordnance delivery.
- (U) Expanded/validated spectral in-band radiance images of aircraft/missile targets and scenes using Flying Infrared Signatures Technology Aircraft (FISTA) aircraft data.

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1010	
- (U) \$4,152	Developed ionospheric specification and forecast techniques for communications, surveillance, navigation, and space system applications.		
- (U)	(U) Incorporated a wideband scintillation statistical model into Scintillation Network Decision Aid (SCINDA) to improve the reliability of satellite communication and warnings of Global Positioning System (GPS) disruptions.		
- (U)	(U) Delivered coupled ionospheric/thermosphere specification model to Air Weather Service to support the 55 <sup>th</sup> Space Weather Squadron (SWS).		
- (U)	(U) Added plasmaspheric populations of hydrogen and helium ions to the Paramaterized Real-Time Ionospheric Specification Model (PRISM) needed to expand its operational utility to higher altitude orbital planes (from 6000 km to geosynchronous earth orbit).		
- (U)	(U) Demonstrated Scintillation Network Decision Aid (SCINDA) technique that exploits real-time ionospheric scintillation data to specify ionospheric disturbances that disrupt Ultra High Frequency (UHF) satellite communication and GPS.		
- (U) \$7,500	Evaluated the interaction between high power, high-frequency, ground transmitted radio waves and the ionosphere.		
- (U)	(U) Augmented, from 360 kilowatt (kW) towards 960 kW, the power of the High Frequency Active Auroral Research Program's (HAARP) transmitter in Alaska, enabling an expanded class of experiments for demonstrating advanced DoD system concepts.		
- (U)	(U) Conducted initial research on generating in the ionosphere Extremely Low Frequency/Very Low Frequency (EHF/VLF) radio waves for potential communications and underground structure/bunker imaging applications.		
- (U) \$4,216	Developed global and theater weather analysis, simulation, and prediction techniques for combat weather system applications.		
- (U)	(U) Delivered theater-scale analysis procedures for combat weather displays and theater weather forecast model initialization to Air Weather Service.		
- (U) \$25,322	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$4,016	Develop space radiation specification and solar hazard prediction techniques for space system design and operations.		
- (U)	(U) Transition increased accuracy radiation belt models to U.S. Air Force system program offices and industry for more survivable satellite designs, orbit selection, trade offs, and reduced outage operations.		
- (U)	(U) Complete initial assessment on the threat of using space particles for both defensive and offensive counterspace activities.		
- (U)	(U) Fabricate space experiment to optically track coronal mass ejections from the sun to near earth space where they can trigger geomagnetic disturbances that cause false launch indicators, satellite tracking errors, and communications disruptions.		
- (U)	(U) Develop magnetic diffusion model for the evolution of active regions on the solar surface, required to forecast the occurrence of solar flares that can disrupt space systems and operations.		
- (U)	(U) Transition data driven solar wind model to 55 <sup>th</sup> Space Weather Squadron for operational use in providing one hour warnings of interplanetary shocks that can trigger geomagnetic disturbances, disrupting space systems and operations.		

Project 1010

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Exhibit R-2 (PE 0602601F)

UNCLASSIFIED

# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory Development

PROJECT

1010

- (U) \$2,943 Develop background clutter mitigation techniques for space system design and operations.
  - (U) Incorporate Mid-course Space Experiment (MSX) and Miniature Sensor Technology Integration (MSTI-3) satellite data into atmospheric background clutter codes MSX space system clutter processing.
  - (U) Develop hyperspectral background clutter suppression and target identification methods for space surveillance with tactical applications.
- (U) \$1,385 Develop active and passive remote sensing techniques for atmospheric parameter measurements.
  - (U) Use advanced modeling and simulation technologies to provide real-time target and background scene generation capability for training and hardware-in-the-loop simulations
  - (U) Terminate development of compact solid state wind sensing lidar for ballistic wind applications (e.g., cargo drops and B-52 bomb drops).
  - (U) Terminate evolution of lidar designs for remote sensing of atmospheric optical and wind turbulence for aircraft safety and surveillance systems.
- (U) \$3,458 Develop global ionospheric models for applications to communications and navigation systems.
  - (U) Transition Global Ionospheric Forecast models to 55 Space Weather Squadron for operational support to Command, Control, Communications, and Intelligence (C3I) systems, the SPACETRACK-space/object tracking system, and ground-based surveillance radars.
  - (U) Demonstrate a ground-based scintillation network decision aid (SCINDA) to provide theater specifications of ionospheric disturbances that cause ultra-high frequency (UHF) satellite communication outages, Global Positioning System (GPS) navigation degradations.
  - (U) Explore and demonstrate space-based techniques to provide a global forecast of ionospheric disturbances that cause milsatcom outages and GPS degradation.
- (U) \$5,000 Characterize the ionospheric Extremely Low Frequency/Very Low Frequency (ELF/VLF) signal generation process.
  - (U) Expand the scope of research by fielding an array of ELF/VLF receivers and adding off-site diagnostics to determine source properties, and provide real-time communication, processing, display and Internet distribution of data.
  - (U) Improve the research infrastructure by completing the operations center in the power plant building, for centralized transmitter control and diagnostic instrument data display.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1010	
- (U) \$3,519	Develop global and theater weather analysis, simulation, and prediction techniques for combat weather system applications including Airborne Laser (ABL).		
- (U) \$20,321	<ul style="list-style-type: none"><li>- (U) Complete validation of satellite data, unified retrieval method to support theater weather forecast models.</li><li>- (U) Incorporate satellite-based cloud module into simulation procedures for system design and testing.</li><li>- (U) Terminate development of a method to incorporate satellite weather data into combat weather support forecast modules.</li></ul>		
- (U) \$20,321	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,944	Develop techniques to specify and predict the space environment for space system design and operations.		
- (U) \$3,944	<ul style="list-style-type: none"><li>- (U) Develop model to forecast coronal mass ejections (CME) and fabricate space experiment to optically track CMEs from sun to earth providing three-to-seven day warning of geomagnetic disturbances.</li><li>- (U) Add alert capability to three-dimensional space environment models used to warn operators, launch crews and users of space systems of conditions detrimental to their mission performance.</li><li>- (U) Validate space storm model for predicting spacecraft charging that creates satellite outages and system failures.</li><li>- (U) Develop physics-based solar wind model to provide a one to three day warning of interplanetary shocks that trigger geomagnetic disturbances causing false missile launch indicators, satellite tracking errors, and communication disruptions.</li><li>- (U) Complete magnetic diffusion model of the evolution of active regions on the solar surface, required to predict the occurrence of solar flares that disrupt space systems and operations with emphasis on preparing for Solar Max (periods of maximum relative solar activity).</li></ul>		
- (U) \$3,369	Develop background clutter mitigation techniques for adaptive hyperspectral space system design.		
- (U) \$1,599	<ul style="list-style-type: none"><li>- (U) Develop optical background clutter models for detecting and tracking dim targets, including missiles.</li><li>- (U) Develop real-time background clutter codes for target tracking satellite operations.</li><li>- (U) Develop active and passive remote sensing techniques for atmospheric parameter measurements and simulation of battlefield environments.</li><li>- (U) Test and evaluate solid-state wind sensing lidars for B-52 applications.</li><li>- (U) Develop compact, solid-state ultraviolet differential absorption lidar for trace gas and chemical detection for use on aircraft.</li></ul>		

Project 1010

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Exhibit R-2 (PE 0602601F)

UNCLASSIFIED

## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

1010

- (U) \$5,545

Develop ionospheric specification and forecast techniques for communications, surveillance, navigation, and space system applications.

-

(U) Develop coupled Ionosphere-Thermosphere-Electrodynamic forecast model (CITEFM) for transition to 55th Space Weather Squadron for operational support of communications, surveillance, navigation, and space-object tracking users.

-

(U) Deliver validated real-time, data driven, Scintillation Network Decision Aid (SCINDA) techniques to 55<sup>th</sup> Space Weather Squadron to provide specification and advance warning of ionospheric disturbed conditions (scintillation) that cause Ultra-High Frequency (UHF)/L-Band satellite communication outages and Global Positioning System (GPS) navigation disruption.

-

(U) Explore and demonstrate space-based techniques to provide global forecasts of ionospheric disturbances that cause UHF satellite communication outages and GPS navigation degradations.

- (U) \$1,000

Develop global and theater weather analysis, simulation and prediction techniques for combat weather systems applications.

-

(U) Tailor numerical weather prediction models to forecast contrails for stealth aircraft operations.

-

(U) Develop radiative cloud module for weather scene simulation techniques for training and wargaming applications.

Total

- (U) \$15,457

Project 1010

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Exhibit R-3 (PE 0602601F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

1010

(U) B. Program Change Summary (\$ in Thousands):(U) Previous President's Budget (FY 1998 PB)  
(U) Current Budget Submit/FY 1999 PBFY 1997  
25,744  
25,322FY 1998  
16,507  
20,321FY 1999  
19,076  
15,457Total  
Cost  
Cont  
Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0601102F, Defense Research Sciences.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.
- (U) PE 0603707F, Weather Systems Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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Exhibit R-2 (PE 0602601F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE							
BUDGET ACTIVITY		PROJECT							
2 - Applied Research		1011							
PE NUMBER AND TITLE		0602601F Phillips Laboratory Exploratory Development							
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1011 Rocket Propulsion Technology	32,651	29,407	35,542	37,121	38,456	37,733	37,575	Continuing	Continuing
<p><b>(U) A. Mission Description and Budget Item Justification:</b> The technologies developed in this project are boost and orbit transfer, satellite maneuvering, and tactical and ballistic missile rocket propulsion. This project develops technologies and provides technology options for rocket propulsion advanced demonstrations, components, or subsystems. Technologies of interest are those which will improve reliability, operability, survivability, affordability, environmental compatibility, and performance of future space and missile launch sub-systems while reducing material, manufacturing, and support costs. Technology will be developed to reduce the weight and cost of components using new materials, improved designs, and improved manufacturing techniques. All efforts in this project are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRT) initiative; a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs.</p> <p><b>(U) FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$2,253 Developed high-energy-density materials.</li> <li>- (U) Completed analysis of solid hydrogen and metallic clusters, metal atom doped cryogenic solids, and solids with impurities. Transitioned the best high-energy-density materials into the cryogenic solid properties and combustion programs. Began testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems.</li> <li>- (U) Finished exploring cryogenic solid, high-pressure solid, and extended solid properties. Determined candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.</li> <li>- (U) Developed techniques to accurately measure high-energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.</li> <li>- (U) Tested fire cryogenic hybrid-fuel rocket using oxygen and a cryogenic hydrocarbon to demonstrate performance increases over current liquid propulsion systems.</li> <li>- (U) Performed large-scale engine tests/demonstrations with new additives (quadricyclane). Prepared for launch-size demonstrations and began transitioning additives into system-ready applications.</li> <li>- (U) Completed strained-ring hydrocarbon high-energy compound development. Identified the best candidates for a scale-up program to replace current liquid fuels.</li> <li>- (U) Selected solid, non-ozone depleting oxidizers and other synthesized, new, high-energy-density materials for development. Began small-scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.</li> </ul>									

Project 1011

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	1011
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development		
<ul style="list-style-type: none"> <li>- (U) \$3,134 Developed propulsion technologies for tactical missile system applications. <ul style="list-style-type: none"> <li>- (U) Tested fabrication techniques to manufacture lightweight solid rocket engine liners.</li> <li>- (U) Completed testing and demonstration of environmentally safe, minimum-smoke propellants to eliminate vulnerability caused by exhaust plume signature tracking.</li> <li>- (U) Developed the fabrication processes for novel nozzle concepts (supersonic splitline flexseal nozzle) that reduce missile weight while increasing missile agility.</li> <li>- (U) Evaluated commercial technologies and practices for their possible incorporation into low-cost, high-performance, environmentally-safe tactical missiles.</li> <li>- (U) Analyzed new propellants and components to develop a lightweight, highly-maneuverable propulsion system that will assure high kill ratios against the next generation of highly maneuverable aircraft.</li> <li>- (U) Continued development of hybrid propulsion systems for potential use as a tactical missile.</li> </ul> </li> <li>- (U) \$14,390 Developed propulsion technology to meet the needs of reliable, safe, and low-cost boost and orbit transfers. <ul style="list-style-type: none"> <li>- (U) Demonstrated low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.</li> <li>- (U) Demonstrated the fluid film bearing designs and verified their performance and integrity when used in liquid turbopumps on future boost and orbit transfer systems.</li> <li>- (U) Designed and tested injectors that enable reduced cost, increased reliability, and increased engine performance in liquid boost and orbit transfer engines.</li> <li>- (U) Fabricated and tested a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application.</li> <li>- (U) Fabricated and tested an advanced preburner engine component that uses liquid cryogenic propellants that meets the high throttling requirements and does not vaporize propellants.</li> <li>- (U) Continued to characterize new materials and developed processes required to apply the materials to liquid-propellant rocket production with dramatic weight reductions.</li> <li>- (U) Developed design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals).</li> </ul> </li> </ul>			

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1011	
- (U) \$6,499	Developed advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, and use.		
- (U)	(U) Evaluated ignition characteristics, determine combustion efficiencies, and report the results of the synthesized non-toxic, non-cryogenic, high-performance, storable liquid fuels and oxidizers to begin developing a high-performance, environmentally safe, liquid replacement for current space launch systems.		
- (U)	(U) Fabricated and tested non-toxic, non-cryogenic, high-performance, storable liquid additives for use with these new propellants (capable of withstanding the firing conditions created by the new propellants).		
- (U)	(U) Determined alternative disposal procedures/technologies to thermolyze or breakdown propellant, explosive, and pyrotechnic wastes into their non-hazardous constituent parts.		
- (U)	(U) Integrated all of the current solid propellant work being done under the high-energy-density materials program and incorporated the most promising chemicals into state-of-the-art propellants (liquid, solid, and hybrid).		
- (U)	(U) Evaluated and analyzed radically new methods of solid rocket motor and propellant manufacturing to develop low-cost, environmentally friendly solid rocket motors that exceed the performance of current liquid propellant rockets.		
- (U)	(U) Scaled-up and demonstrated the most innovative high-energy chemicals that are currently being synthesized within government and contractor laboratories. The most promising chemicals (solid or liquid) will be fed into an innovative propellants project to be used in next generation propellants for space launch systems.		
- (U) \$2,525	Developed techniques for use in sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.		
- (U) \$3,850	(U) Continued the development of service life assessment techniques of current solid rocket propellant missile systems.		
- (U)	Developed satellite propulsion technology for control and on-orbit transfer.		
- (U)	(U) Developed and evaluated improved designs to fabricate a pulsed plasma thruster with increased power efficiency.		
- (U)	(U) Designed solar thrusters and concentrators for satellite propulsion systems with longer life.		
- (U) \$32,651	(U) Developed and improved technologies for implementation of the high power Hall thruster.		
- (U) \$32,651	Total		

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Exhibit R-2 (PE 0602601F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		<b>DATE</b> February 1998
<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>	<b>PE NUMBER AND TITLE</b> <b>0602601F Phillips Laboratory Exploratory Development</b>	<b>PROJECT</b> <b>1011</b>

(U) FY 1998 (\$ in Thousands):

- (U) \$3,442 Develop propellants with a high-energy density.
  - (U) Continue testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems. These potential propellants were selected from the previously conducted analysis of solid hydrogen and other cryogenic solids, doped with high energy impurities such as atoms and dimers of lightweight elements and metals.
  - (U) Begin sub-scale testing of potential candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.
  - (U) Build low temperature hazards testing apparatus with capability to test energetic cryosolids as well as propellants at cold temperatures they might experience in field applications.
  - (U) Continue testing and comparison of techniques to accurately measure high energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.
  - (U) In collaboration with NASA, scale up selected energetic hydrocarbons for further testing in larger quantities.
  - (U) Begin new energetic hybrid rocket fuels development
  - (U) Continue selection of solid, non-ozone depleting oxidizers and other synthesized, new, high energy-density materials for development. Continue small-scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1011	
<p>           - (U) \$14,998             - (U) \$3,601             -- (U) \$6,000         </p>	<p>Develop propulsion technology for reliable, safe, and low-cost boost and orbit transfers.</p> <ul style="list-style-type: none"> <li>- (U) Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.</li> <li>- (U) Complete fabrication and testing of an advanced preburner engine component that uses liquid cryogenic propellants that meets the high throttling requirements and does not vaporize propellants.</li> <li>- (U) Complete demonstration of the fluid film bearing designs and verify their performance and integrity when used in liquid turbopumps on future boost and orbit transfer systems.</li> <li>- (U) Complete fabrication and test of a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application.</li> <li>- (U) Continue to characterize new materials and develop processes required to apply the materials to liquid-propellant rocket production with dramatic weight reductions.</li> <li>- (U) Continue to develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals).</li> <li>- (U) Continue development of altitude compensating thrust chamber assembly technology improvements which will provide significant gains in performance for reusable launch vehicles.</li> </ul>		
	<p>Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.</p> <ul style="list-style-type: none"> <li>- (U) Complete fabrication of spacecraft thruster and begin using it for evaluation of high energy monopropellant candidates.</li> <li>- (U) Continue the fabrication and testing of non-toxic, non-cryogenic, high-performance, storable liquid additives for use with the above new propellants (capable of withstanding the firing conditions created by the new propellants).</li> <li>- (U) Begin research and development of pulsed detonation rocket engine.</li> </ul>		
	<p>Develop technologies for use in long-term sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.</p> <ul style="list-style-type: none"> <li>- (U) Begin development of compatible case/liner and insulator system for higher combustion temperature propellants to be used in strategic systems.</li> <li>- (U) Begin development of tools to increase the look-ahead capability in determining the age life of strategic and other solid rocket motors.</li> <li>- (U) Begin development of improved and replacement propellants and materials for both solid and liquid postboost control systems for application to strategic missiles with the purpose of developing technologies that are more readily available over the life of strategic systems (i.e., 20+ years).</li> </ul>		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1011	
- (U) \$1,366	Develop propulsion technology for satellite control and on-orbit transfer.		
- (U)	(U) Continue the Hall thruster development for possible inclusion into the next generation satellites.		
- (U)	(U) Continues work in the development and evaluation of improved designs to fabricate pulsed plasma thrusters with increased power efficiency, the next level of improvements.		
- (U)	(U) Continue the design and test of solar thrusters and concentrators for satellite propulsion systems with longer life.		
- (U) \$29,407	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,762	Develop propellants with a high-energy density.		
- (U)	(U) Continue testing and evaluation of downselected propellants to transition into future high-performance boost and orbit transfer propulsion systems. These potential propellants were selected from the previously conducted analysis of solid hydrogen and other cryogenic solids, doped with high energy impurities such as atoms and dimers of lightweight elements and metals.		
- (U)	(U) Begin sub-scale testing of potential candidates for cryogenic solid combustion programs that will show revolutionary performance increases by replacing current liquid or solid propulsion systems with cryogenic solid or hybrid-fuel rockets in future space launch missions.		
- (U)	(U) Continue testing and comparison of techniques to accurately measure high energy-density additive concentrations in cryogenic solids to maximize future propulsion system performance.		
- (U)	(U) Complete performance of large-scale engine tests/demonstrations with new additives (quadricyclane). Continue preparation for launch-size demonstrations and transitioning additives into system-ready applications.		
- (U)	(U) Begin evaluation of next generation of hydrocarbon fuel additives to improve the performance of current and future space launch systems.		
- (U)	(U) Continue selection of solid, non-ozone depleting oxidizers and other synthesized, new, high energy-density materials for development. Continue small-scale demonstrations of environmentally-safe solid rocket motor fuel processing using these new ingredients.		

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Exhibit R-2 (PE 0602601F)

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# RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory Development

PROJECT

1011

- (U) \$2,985

Develop propulsion technologies for tactical missiles.

- Continue scale-up of minimum smoke propellant formulations which reduce system vulnerability due to exhaust plume signature.
- Continued exploration of nozzle and insulation materials that are compatible with the above propellants. Coordination with Navy and Army tactical missile programs is extensive.
- Continue development of hybrid propulsion as part of an international cooperative project to develop this propulsion technology for application to tactical missiles. This is technology can provide very significant increases in range and average velocity and is coordinated extensively with Navy and Army programs.

- (U) \$7,616

Develop propulsion technology for reliable, safe, and low-cost boost and orbit transfers.

- (U) Continue to demonstrate low-cost, high temperature, non-erosive, lightweight coated carbon-carbon ceramic and hybrid polymer components for use in solid rocket space launch and missile motors.
  - (U) Complete demonstration of the fluid film bearing designs and verify their performance and integrity when used in liquid turbopumps on future boost and orbit transfer systems.
  - (U) Complete fabrication and test of a high-performance, low-cost cryogenic upper stage combustion chamber for an expander cycle application.
  - (U) Continue to characterize new materials and develop processes required to apply the materials to liquid-propellant rocket production with dramatic weight reductions.
  - (U) Continue to develop design and processing techniques for high-strength, low-weight engine and motor components (metals and non-metals).
  - (U) Continue development of altitude compensating thrust chamber assembly technology improvements which will provide significant gains in performance for reusable launch vehicles.
  - (U) Verify performance and weight improvements of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles.
- Develop advanced boost and orbit transfer propellants which are environmentally safe during manufacture, storage, use, and disposal.
- (U) Continue the evaluation of ignition characteristics, determine combustion efficiencies, and report the results of the synthesized non-toxic, non-cryogenic, high-performance, storable liquid fuels and oxidizers to begin developing a high-performance, environmentally safe, liquid replacement for current space launch systems.
  - (U) Continue the fabrication and testing of non-toxic, non-cryogenic, high-performance, storable liquid additives for use with the above new propellants (capable of withstanding the firing conditions created by the new propellants).
  - (U) Continue research and development of pulsed detonation rocket engine.

- (U) \$10,093

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	1011	
- (U) \$8,000	Develop technologies for use in long-term sustainment of strategic systems while at the same time being potentially advantageous to the development of the next generation booster.		
	- (U) Continue development of compatible case/liner and insulator system for higher combustion temperature propellants to be used in strategic systems.		
	- (U) Continue development of tools to increase the look-ahead capability in determining the age life of strategic and other solid rocket motors.		
	- (U) Continue development of improved and replacement propellants and materials for both solid and liquid postboost control systems for application to strategic missiles with the purpose of developing technologies that are more readily available over the life of strategic systems (i.e., 20+ years).		
- (U) \$3,086	Develop propulsion technology for satellite control and on-orbit transfer.		
	- (U) Continue work in the development and evaluation of improved designs to fabricate pulsed plasma thrusters with increased power efficiency.		
	- (U) Continue the design and test of solar thrusters and concentrators for satellite propulsion systems with longer life.		
- (U) \$35,542	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

1011

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	33,863	29,505	36,509	Cost
	32,651	29,407	35,542	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 060211IN, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0602303A, Missile Technology.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) PE 0603311F, Ballistic Missile Technology.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

3326

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3326 Lasers and Imaging Technology	16,771	18,485	19,376	20,096	19,924	20,525	20,815	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project examines the technical feasibility of moderate to high power lasers, associated optical components, and long-range optical imaging concepts required for Air Force missions. Technologies researched include advanced, short-wavelength laser devices for application as illuminators and imaging sources as well as advanced optical imagers for target identification and assessment. Laser technologies will be studied for their utility in airpoint selection, target maintenance, and damage assessment. Additionally, high power laser devices, mid-infrared semiconductor laser devices, semiconductor diode laser arrays, optical components, advanced beam control and atmospheric compensation technologies, techniques for laser target vulnerability assessments, and nonlinear optics processes and techniques are developed.

(U) FY 1997 (\$ in Thousands):

- (U) \$2,625 Developed generic, high energy laser technologies for applications such as illuminators for use in wavelength-specific military missions.
- (U) Demonstrated lasing at 5.1 microns for a semiconductor laser.
- (U) Demonstrated a three-pass stable resonator concept and produced a single mode, five kilowatt continuous wave beam.
- (U) Demonstrated production of nitrogen chloride and scaling potential of atomic-iodine laser.
- (U) Developed the magnetic gain switch hardware necessary to demonstrate a ten kilohertz repetitively pulsed chemical oxygen-iodine laser.
- (U) Demonstrated a continuous-wave, single-frequency portable laser.
- (U) Completed a laser illuminator study to meet future Air Force requirements.
- (U) \$1,013 Developed basic laser source and targeted coupling technology for use in high-payoff applications such as infrared countermeasures and creating laser-induced microwave effects.
- (U) Completed field test series which demonstrated capabilities of concept over extended ranges.
- (U) Developed two mid-infrared lasers operating at three and four microns for infrared countermeasures use.
- (U) Completed experiment and analysis to assess the effectiveness of laser-induced microwave emissions in military applications; results provided a database on a novel effect used for upsetting electronic systems.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	3326	
- (U) \$2,320	<p>Developed long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification and ground target identification from space.</p> <ul style="list-style-type: none"> <li>- (U) Conducted initial development of experiments on active and passive spectral technologies which increase performance and reduced cost of space-based optical sensors used for ground target identification.</li> <li>- (U) Developed advanced concepts for smart integrated sensor-processors to reduce data bandwidth requirements on space-based sensors.</li> <li>- (U) Developed advanced concepts for lightweight deployable large optics to permit long dwell optical surveillance from higher orbits.</li> <li>- (U) Developed the Atlas laser which produces the highest average power brightness ever reported at the 1.06 micron and 532 nanometer wavelengths. This diode-pumped, solid-state laser, with excellent beam quality, was installed at Kirtland's Starfire Optical Range for active tracking experiments and for use as a Raleigh Beacon.</li> </ul>		
- (U) \$1,935	<p>Investigated and developed nonlinear optics (NLO) technologies to support imaging and other applications.</p> <ul style="list-style-type: none"> <li>- (U) Continued to characterize automatic, all-optical techniques for producing pristine images from large, lightweight mirrors.</li> <li>- (U) Initiated an effort to produce a very efficient, mid-infrared source that uses a standard, near-infrared solid state laser and multiple nonlinear optical processes.</li> <li>- (U) Began studying NLO techniques for high bandwidth laser communications, automatic aimpoint maintenance, and lightweight optics for space applications. These techniques have the potential to increase communication data rates, reduce system size, weight and complexity, and improve system efficiency.</li> <li>- (U) Demonstrated an all-optical technique for correcting gross surface deformation errors in inflatable mirrors.</li> <li>- (U) Extended the operational modulation bandwidth of commercial diode laser by a factor of twenty. Performed a laboratory demonstration of an NLO technique for automatically acquiring and establishing an optical communication crosslink. These techniques have the potential to increase optical communication data rates, reduce system size, weight and complexity, and improve system efficiency.</li> <li>- (U) Demonstrated two sources of frequency-tunable, mid-infrared radiation based on NLO crystals pumped by standard, fixed-frequency, near-infrared, solid state lasers. Sources represented the most powerful, tunable sources in this spectral regime. The sources were transitioned to field tests.</li> </ul>		
- (U) \$1,980	<p>Investigated and developed advanced, high energy laser optical components.</p> <ul style="list-style-type: none"> <li>- (U) Completed development of techniques to evaluate optical components installed in operational high energy laser systems for transition to advanced technology development.</li> </ul>		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	3326
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development		
	<ul style="list-style-type: none"> <li>- Completed testing and accepted delivery of cooled, transmissive optical element which is environmentally safe, and relieves thermal overload in optical systems.</li> <li>- (U) Completed development of very low absorption, low-scatter optical, thin-film coatings. Transitioned technology to industry for scaling. This work will result in reduced cooling requirements, less optical distortion, decreased size and weight, and increased efficiency of optical systems used in airborne and space platforms.</li> <li>- (U) Designed and deposited optical coatings on three large optics (one 22-inch and two 36-inch) for use at the Starfire Optical Range.</li> <li>- (U) Identified a non-toxic, low-absorption coolant for use in a cooled transmissive optics operating at 1.315 microns. Also developed an optical contacting process for assembly of this type of optic. Active cooling of transmissive elements, such as beamsplitters, will reduce optical distortion due to laser heating.</li> <li>- (U) Designed, fabricated, and delivered a set of coating samples for incorporation into the Optical Properties Monitor (OPM) Experiment to determine the effect of the space environment on optical properties of coatings and materials. OPM is currently on Russia's Mir space station.</li> </ul>		
- (U) \$3,552	Developed laser radar for space surveillance and remote sensing applications.		
- (U) \$3,346	<ul style="list-style-type: none"> <li>- (U) Demonstrated capabilities to collect range, range rate, and doppler images against unaugmented low-earth orbit satellite. The technology provides improved range resolution and system operation without illumination from the sun.</li> <li>Developed high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and infrared (IR) missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules and infrared countermeasures (IRCM).</li> <li>- (U) Demonstrated ten watts peak output power at two microns continuous wave operation from a semiconductor diode laser array module at room temperature. This demonstration provides a baseline for high efficiency pump laser arrays used as subcomponent in Band 4 optically-pumped semiconductor lasers, as well as a robust source for Band 1 IRCM.</li> <li>- (U) Demonstrated 100 milliwatts continuous laser output power at four microns from a single semiconductor diode. The data collected will be used to scale output power to levels required for next generation, high efficiency, compact Band 4 IRCM sources for small tactical aircraft self-protection -- a requirement which cannot be met by bulkier optically-pumped semiconductor lasers.</li> </ul>		
- (U) \$16,771	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$872	Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.		
	- (U) Apply FY 1997 experimental results to technology demonstration of a high energy, chemical nitrogen chloride iodine transfer laser. This laser has the potential to be significantly lighter weight than a comparable chemical oxygen-iodine laser.		

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	3326	
- (U) \$2,678	Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification.		
	- (U) Develop initial experiments on active and passive spectral technologies which increase performance and reduce cost of space-based optical sensors used for ground target identification.		
	- (U) Evaluate on-board image processing concepts to decrease communication bandwidth requirements.		
	- (U) Establish lab test facility for large deployable optics technology and smart sensors.		
- (U) \$1,460	Investigate and develop advanced laser radar for space surveillance and remote sensing using transceiver systems, and advanced data collection and processing algorithms for laser radar (LADAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield.		
	- (U) Develop wavelength tunable laser heterodyne receiver technologies for advanced detection use.		
	- (U) Develop models of advanced detection method performance based on heterodyne technologies.		
	- (U) Investigate data analysis tools for real-time chemometric identification capability.		
- (U) \$4,659	Develop laser source and target coupling technology for next-generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers.		
	- (U) Begin investigating effects of laser illumination on materials relevant to degrade and damage infrared countermeasures (IRCM) applications.		
- (U) \$1,652	Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.		
	- (U) Transition technology for automatic, all-optical compensation techniques for large lightweight mirrors with poor optical quality to imaging satellite systems development projects. Nonlinear optics are an improvement over currently used technologies by providing a more compact, lighter weight, faster, and less complex system for correcting figure errors.		
	- (U) Demonstrate a tunable mid-infrared laser converter with better than 50% conversion efficiency from the near-infrared. This converter could potentially improve infrared countermeasures (IRCM) and sensing system efficiencies by a factor of two.		

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Exhibit R-2 (PE 0602601F)

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

0602601F Phillips Laboratory Exploratory

## PROJECT

**3326**

- |   |     |                                                                                                                                                                                                                                                                                                                                                                                           |          |
|---|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| - | (U) | Begin investigating NLO techniques to decrease system complexity and increase speed of aimpoint imaging and tracking for countermeasure applications.                                                                                                                                                                                                                                     |          |
| - | (U) | Continue to investigate NLO techniques to increase current laser communication bandwidths with automatic crosslink acquisition and tracking and lightweight optics. The use of NLO will provide a more lightweight, efficient communications system capable of handling more information.                                                                                                 |          |
| - | (U) | Develop high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and infrared (IR) missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats.                               | \$4,076  |
| - | (U) | Demonstrate an incoherent 20 watt peak output power, continuous wave operation, two micron semiconductor diode laser array module at room temperature. This device will provide a compact, high power, efficient pump laser array used as a subcomponent in Band 4 optically-pumped semiconductor lasers to increase their performance.                                                   |          |
| - | (U) | Demonstrate 750 milliwatts continuous laser output power at four microns wavelength from a single semiconductor diode. This demonstration will establish the feasibility of direct electrical-to-optical generation of mid-infrared wavelengths, enabling improved packing efficiency and reliability by a factor of two for small tactical aircraft self-protection.                     |          |
| - | (U) | Demonstrate two watts coherent peak output power at quasi-continuous wave operation from a single, Band 1 semiconductor diode at room temperature. The collected data will demonstrate the necessary powers needed to jam Band 1 infrared surface-to-air missiles. Develop coherent laser diode arrays for improved performance/higher power in applications requiring high power levels. | \$3,088  |
| - | (U) | Demonstrate 100 watts continuous wave power from an array of phased diode lasers to establish the baseline technology for advanced laser defenses such as large aircraft self-protection.                                                                                                                                                                                                 |          |
| - | (U) | Demonstrate and evaluate a 200 watt high power system with a one cubic foot laser head. This one cubic foot design will provide the basis for high performance aircraft and space asset self-protection system designs.                                                                                                                                                                   |          |
|   | (U) | Total                                                                                                                                                                                                                                                                                                                                                                                     | \$18,485 |

(U) FY 1999 (\$ in Thousands):

- |       |         |                                                                                                                                                                                                                                                                                                                            |
|-------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| – (U) | \$1,092 | Develop generic, high energy laser technologies for applications such as illuminators and use in wavelength-specific military missions.                                                                                                                                                                                    |
| – (U) |         | – (U) Demonstrate a repetitively-pulsed, high average power, frequency-shifted chemical oxygen-iodine laser for use as a target illuminator.                                                                                                                                                                               |
| – (U) | \$3,837 | – (U) Develop scaling methodology for an all-electric, radio frequency-excited wave guide laser for aircraft application.<br>Develop long-range optical imaging technologies for increased resolution and data fusion to support missions such as space object identification and ground target identification from space. |

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2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	3326	
	<ul style="list-style-type: none"><li>- (U) Conduct initial experiments on 75 cm inflatable telescope mirror. This technology offers a dramatic reduction in weight for space-based optics.</li><li>- (U) Conduct initial field experiments to evaluate the utility of space-based hyperspectral sensors for improved support for military operations.</li><li>- (U) Evaluate on-board processing concepts to decrease satellite to earth communications requirements. This technology will deliver information much more quickly to the warfighter.</li><li>- Develop remote optical sensing capabilities that demonstrate capabilities to identify and quantify battlefield gases in the atmosphere for both airborne and space applications.</li></ul> Investigate and develop advanced laser transceiver systems, and advanced data collection and processing algorithms for light detection and ranging (LIDAR) remote sensing of atmospheric properties, chemical agents, and target effluents, and intelligence preparation of the battlefield.		
- (U) \$1,502			
	<ul style="list-style-type: none"><li>- (U) Develop and characterize wavelength tunable heterodyne receiver. Integrate into breadboard LIDAR system.</li><li>- (U) Perform laboratory demonstration of heterodyne LIDAR (short-range field tests).</li><li>- (U) Develop advanced detection analysis techniques using heterodyne methodology data.</li></ul> Develop laser source and target coupling technology for next-generation high-payoff applications such as damage/destroy countermeasures against infrared imaging seekers.		
- (U) \$2,977			
	<ul style="list-style-type: none"><li>- (U) Begin development of improved surrogate threats for laboratory investigations.</li><li>- (U) Begin development of advanced lasers and high accuracy pointer/tracker for potential use in infrared countermeasures (IRCM).</li><li>- (U) Identify the laser characteristics required for an optimum damage and destroy device.</li></ul>		
	Investigate and develop nonlinear optics (NLO) technologies to support imaging and other applications.		
- (U) \$704	<ul style="list-style-type: none"><li>- (U) Continue improving performance of NLO devices to new regimes of operations: higher output powers; longer wavelengths; higher efficiencies. NLO techniques represent a powerful paradigm for leveraging off of technology investments in fixed-frequency laser sources for use in frequency conversion applications providing reduction in size, weight, power, and complexity while improving performance and efficiency.</li></ul>		
	Develop high power semiconductor lasers/arrays at alternate wavelengths for applications and uses such as forward looking infrared (FLIR) systems and infrared (IR) missile warning sensor jamming, chemical agent detection, illuminators, efficient semiconductor laser array pumping modules, and disrupt/jam countermeasures against near-term threats.		
- (U) \$4,849			

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	3326	
<ul style="list-style-type: none"><li>- (U) Demonstrate 100 watts incoherent peak output power at quasi-continuous wave operation from a two micron semiconductor diode laser array module at room temperature. This demonstration will provide a baseline for high efficiency pump sources used as a subcomponent in portable, high brightness Band 4 optically-pumped semiconductor lasers for FY 2000 field experiments.</li><li>- Demonstrate 0.5 watts average output power at greater than four microns from a semiconductor laser to establish the baseline for all laser-based small tactical aircraft self-protection capabilities.</li><li>- Develop monolithic, coherent lasers for tactical/unmanned air vehicle and space applications such as designation/illumination and remote sensing which require higher power sources.</li><li>- (U) Demonstrate fast electronic beam steering in a greater than 100 watt output power continuous wave array of phased diode lasers at 980 nanometers.</li><li>- (U) Demonstrate a greater than 100 watt dual core fiber laser/array building blocks for use in multi-kilowatt laser systems.</li><li>- (U) \$4,415</li><li>- (U) \$19,376</li><li>- Total</li></ul>			

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0602601F Phillips Laboratory Exploratory  
Development

3326

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	18,553	21,252	20,716	
(U) Current Budget Submit/FY 1999 PB	16,771	18,485	19,376	

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0602101N, Directed Energy Weapons.
- (U) PE 0602307A, Laser Weapon Technology.
- (U) PE 0603314A, High Energy Laser and Directed Energy Components.
- (U) PE 0603319F, Airborne Laser Demonstrator.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

5797

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5797 Advanced Weapons and Survivability Technology	14,072	14,468	14,645	15,834	16,159	16,779	17,188	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: High power microwave (HPM) and other unconventional weapon concepts using innovative technologies are explored in this project. Technologies that support a wide range of Air Force missions such as suppression of enemy air defenses, command and control warfare, and vehicle self-protection are developed. This project provides for vulnerability assessments of representative U.S. strategic and tactical systems to directed energy weapons, directed energy weapon technology assessment for specific Air Force missions, and directed energy weapon lethality assessments against foreign targets. In addition to directed energy weapon threats, this project conducts assessments of specific space environmental (natural and man-made) effects on space systems and develops hardening technologies and methodologies.

(U) FY 1997 (\$ in Thousands):

- (U) \$4,536 Developed generic advanced weapon technologies that support many Air Force applications.
- (U) Continued to develop advanced pulse-power, microwave, and radio-frequency technologies for offensive and defensive weapon systems.
- (U) Improved high-performance computer codes to support narrowband HPM source and pulsed power research.
- (U) Began development of first-generation, compact, high-voltage pulsed electrical power generator for microwave and radio frequency sources.
- (U) Began assessment of the ability of pulsed power and HPM technology to neutralize biological weapons.
- (U) Continued to develop narrowband and wideband sources and antennas.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	5797	
- (U) \$2,414	Assessed effects/lethality of directed energy weapon technologies against representative air and ground military systems.		
	- (U) Progress made in developing computer modeling codes that model high power microwave (HPM) coupling into cockpit areas of advanced technology aircraft. Small-aircraft simulator was used to make wide variety of direct-injection HPM experiments which yielded data on HPM effects on subsystems.		
	- (U) Proposed protection technology presented to F-16 system program office (SPO) for their consideration; assessment of aircraft susceptibilities to wide-band HPM continued.		
	- (U) Numerical analyses and associated experimental measurements were made on a large group of command and control warfare hardware assets.		
	- (U) Large group of space-related electronics and command and control warfare electronics were investigated for type and threshold of effects caused by different HPM threats.		
	- (U) Extensive HPM coupling measurements were performed on C-130 aircraft. Criteria for protection for mission-essential electronics were developed.		
- (U) \$3,265	Developed HPM technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection.		
	- (U) Extensive experimental measurements conducted on key elements of a command and control installation.		
	- (U) Solid state source technology was selected for aircraft self protection application. Two large experimental efforts provided valuable information on source waveform requirements.		
	- (U) Refined computer models of weapon effectiveness for all weapon applications.		
	- (U) The down-selected narrow-band source for suppression of enemy air defenses demonstrated capability to defeat older (harder) technology mobile command and control center.		
- (U) \$2,182	Developed HPM technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.		
	- (U) Executed susceptibility experiments and analysis of effects on two subsystems and two devices.		
	- (U) Selected and evaluated technologies that lead to selection of best concepts for basing of HPM technology.		
	- (U) Developed requirements for source technology development in support of threat demonstration.		
	- (U) Began to develop experimental methodologies to measure effects of HPM on satellite systems.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	5797	
- (U) \$1,675	Assessed the vulnerability of various space assets to threats such as solar radiation and directed energy weapons.		
- (U) \$5,688	<ul style="list-style-type: none"><li>(U) Improved directed energy weapon lethality and assessment models for five satellites.</li><li>(U) Continued satellite survivability/vulnerability/lethality assessments for ground-based laser technology.</li><li>(U) Transitioned advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.</li></ul>		
- (U) \$14,072	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$5,688	Develop generic advanced weapon technologies that support many Air Force applications.		
- (U) \$1,864	<ul style="list-style-type: none"><li>(U) Apply high performance, parallel, plasma physics computer codes to narrowband source and compact pulsed power design.</li><li>(U) Perform integrated experiments to assess coupling compact, high voltage electrical generators; gigawatt narrowband devices; and efficient antennas.</li><li>(U) Complete development of high power, first generation wideband source, including antenna.</li><li>(U) Complete the assessment of the ability of pulsed power and high power microwave (HPM) technology to neutralize biological weapons.</li></ul>		
	Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.		
	<ul style="list-style-type: none"><li>(U) Continue to identify HPM protection requirements for large aircraft (cargo-transport and bombers) carrying future HPM devices.</li><li>(U) Continue to develop practical methods to protect existing and advanced technology aircraft from proposed/identified external HPM threats.</li><li>(U) Continue to develop techniques and technology to evaluate HPM coupling and effects into hardened, command-post like structures with modern electronics.</li><li>(U) Continue to develop and validate techniques to evaluate HPM effects on families of electronics components found in difficult-to-obtain weapons/threats.</li><li>(U) Continue to develop and validate advanced computer models which provide predictions for HPM coupling and effects into a wide variety of structures (command posts) and weapons systems of moderate complexity.</li></ul>		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602601F Phillips Laboratory Exploratory Development		PROJECT 5797

## 2 - Applied Research

**0602601F Phillips Laboratory Exploratory**

DATE **February 1998**

5797

- |       |          |                                                                                                                                                                                      |
|-------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) | \$3,154  | Develop high power microwave (HPM) technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection. |
| - (U) |          | Use new technology ultra-wideband (UWB) sources to perform effects experiments on structures with command and control electronics systems.                                           |
| - (U) |          | Prepare and implement diagnostic procedures and instrumentation for a critical experiment to demonstrate UWB capability to defeat infrared seekers.                                  |
| - (U) |          | Improve transition of computer modeling code and experimental data into operational (flyout) modeling codes to model HPM effects on postulated missile threats.                      |
| - (U) |          | Integrate previously down-selected narrow-band source with newly developed pulsed-power generator for suppression of enemy air defenses.                                             |
| - (U) | \$1,890  | Develop high power microwave (HPM) technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.     |
| - (U) |          | Transition effects analysis and experimentation from subsystem to systems, begin to demonstrate and quantify effects on systems.                                                     |
| - (U) |          | Thoroughly evaluate best basing mode for HPM technology demonstration.                                                                                                               |
| - (U) |          | Begin source development to support threat demonstration.                                                                                                                            |
| - (U) | \$1,872  | Assess the vulnerability of various space assets to threats such as solar radiation and directed energy weapons.                                                                     |
| - (U) |          | Continue to develop directed energy weapon lethality and assessment models for five satellites.                                                                                      |
| - (U) |          | Continue satellite survivability/vulnerability/lethality assessments for ground-based laser technology.                                                                              |
| - (U) |          | Continue to transition advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.                                                                |
| - (U) | \$14,468 | Total                                                                                                                                                                                |

(U) FY 1999 (\$ in Thousands):

- |       |         |                                                                                                                                                                    |
|-------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) | \$6,074 | Develop generic advanced weapon technologies that support many Air Force applications.                                                                             |
| -     | (U)     | Develop and test components for next-generation, compact, high voltage, high impedance, pulsed electrical power sources for microwave and radio frequency sources. |
| -     | (U)     | Complete the transition of high performance plasma physics computer simulation codes to designers of microwave and pulsed power devices.                           |
| -     | (U)     | Develop technology to increase the energy efficiency of multiwatt narrowband sources.                                                                              |
| -     | (U)     | Develop technologies for next-generation wideband sources and antennas.                                                                                            |

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## 2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

5797

- (U) \$2,046 Assess effects/lethality of directed energy weapon technologies against representative air and ground military systems.
  - (U) Finalize development of computer modeling codes that predict high power microwave (HPM) coupling into advanced technology aircraft.
  - (U) Begin transitioning specifications and standards and HPM hardness technologies to fighter aircraft.
  - (U) Continue directed energy weapon lethality/survivability enhancements and characterization of equipment upset of various foreign and U.S. systems for advanced tactical applications.
  - (U) Transfer HPM protection technology for large aircraft, such as cargo-transport, air-refueling, and bomber aircraft.
  - (U) Continue effects experiments on networks typical of command and control facilities.
- (U) \$3,425 Develop HPM technologies that will support applications such as suppression of enemy air defenses, command and control warfare, and aircraft self-protection.
  - (U) Finalize in situ experimentation with installed systems for command and control warfare using HPM.
  - (U) Continue in situ demonstrations of selected HPM sources that could be used for aircraft self-protection and other advanced tactical applications.
  - (U) Continue to improve and validate computer models of weapon effectiveness for all weapon applications.
  - (U) Demonstrate technology applicability for advanced tactical applications with an experiment using a downselected source.
- (U) \$1,286 Develop HPM technologies, including susceptibility and effects experiments and modeling and data base development, to support space control applications.
  - (U) Continue source technology development to support threat demonstration.
  - (U) Continue susceptibility experiments on subsystems to support threat demonstration.
- (U) \$1,814 Assess the vulnerability of various space assets to threats such as solar radiation, space debris, and directed energy weapons.
  - (U) Select directed energy weapon lethality and assessment models for five satellites.
  - (U) Continue survivability/vulnerability/lethality assessments for ground-based laser technology.
  - (U) Continue to transition advanced data fusion techniques to the multi-spectral, multi-sensor data analysis workstation.
- (U) \$14,645 Total

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PROJECT

5797

## (U) B. Program Change Summary (\$ in Thousands):

- (U) Previous President's Budget (FY 1998 PB)
- (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	16,039	15,403	15,950	Cost
	14,072	14,468	14,645	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

## (U) C. Other Program Funding Summary:

### (U) Related Activities:

- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603605F, Advanced Weapons Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

## (U) D. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory  
Development

PROJECT

8809

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
8809 Space and Missile Technology	49,667	35,585	31,119	41,678	47,182	50,241	51,305	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project focuses on five major space and missile technology areas: spacecraft platform technologies (e.g., structures, controls, power, and thermal management); space-based payload technologies (e.g., sensors, satellite communications, and survivable electronics); satellite control technologies (e.g., spacecraft software); ballistic missile/launch vehicle specific technologies (e.g., astrodynamics and guidance, navigation, and control avionics); and integrated experiments of advanced technologies for transition to planned systems (e.g., payload/platform/launch vehicle merging).

(U) FY 1997 (\$ in Thousands):

- (U) \$5,206

Developed technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.

- (U) Completed solar cell flexible array technology trade studies.

- (U) Initiated development program for ultra-high efficiency four-junction photovoltaic and thermal electric cells.

- (U) Continued development of solid state primary battery for space and missile launch vehicle applications.

- (U) Began development of lightweight flywheel integrated power and attitude control systems (IPACS); goal is seven-fold decrease in subsystem weight.

- (U) Initiated cryocooler component reliability characterization study.

- (U) Designed, fabricated, and flight-qualified capillary pumped loop/looped heat pipe thermal management systems for distributed and load sharing applications.

- (U) \$4,916

Developed technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.

- (U) Continued research efforts in adaptive structures technology emphasizing Adaptive Neural Control (ANC).

- (U) Fabricated, tested, and integrated an advanced isolation system into the Space Test Research Vehicle 2 (STRV2) spacecraft to stabilize an electro-optic camera.

- (U) Continued joint program to develop advanced mechanisms which will improve the design of solar array subsystems.

- (U) Fabricated, tested, and flight demonstrated advanced lightweight launch vehicle structures.

- (U) Continued the development of multifunctional spacecraft structures.

- (U) Initiated space-based radar structures program.

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Development

PROJECT

8809

- (U) \$4,556

Developed technologies for space-based payload subsystems such as hardened sensors and satellite communications.

- (U) Continued improvement of long-wavelength mercury cadmium telluride detectors and optimized design for large focal plane arrays.
- (U) Continued development of larger format, quantum well, infrared photodetector focal plane arrays.

- (U) Evaluated and characterized radio frequency communications modem, modem controllers and network components.

- (U) Integrated space-based surveillance antenna component technologies to support system level design concepts.

- (U) \$3,411

Developed technologies for space-based payload components such as hardened electronics and memories.

- (U) Evaluated and fabricated advanced packaging technology whose goal is a ten times size/volume/weight reduction.

- (U) Initiated evaluation of a standard space-based surveillance signal processing module.

- (U) \$3,263

Developed technologies for satellite control, astrodynamics, modeling and simulation, and autonomous operations.

- (U) Developed satellite control software for applications such as multi-mission advanced ground intelligent control.

- (U) Developed next generation astrodynamics models for orbit determination and collision risk assessment.

- (U) Developed simulation architecture for space-based surveillance models.

- (U) Evaluated software for autonomous space technology product development.

- (U) \$16,904

Developed ground and small satellite integration technologies for space and near-space experiments.

- (U) Completed MightySat I spacecraft and experiments assembly. Integrated experiments with spacecraft. Technologies to be evaluated include: increased power solar cells; lightweight composite structures; shape memory release device; microparticle impact detector; and electronics miniaturization techniques. Performed environmental test and checkout. Integrated MightySat I on Shuttle Hitchhiker Ejection System for launch on shuttle flight Shuttle Transportation System 88 (STS-88).

- (U) Assembled and integrated exploratory, hardware-in-the-loop satellite technologies to validate overall sparse optical array concept through the UltraLITE ground demonstration, a large high precision space mirror.

- (U) Designed the baseline MightySat Phase II vehicle. Tailored vehicle basic design to meet requirements of first flight which will demonstrate nine distinct experiments. These include a Fourier transform hyperspectral imager, pulsed plasma thrusters, multi-functional structures, miniaturized electronics, and a solar array concentrator.

- (U) Developed near-space capabilities for experiments requiring high altitudes and guided recovery systems.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	8809	
- (U) \$1,908	Developed technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights.		
-	(U) Began fabrication of solid state micro-mechanical guidance instruments for future ballistic missile environments.		
-	(U) Evaluated a next generation thrust axis accelerometer.		
-	(U) Continued development of improved techniques to determine accurate gravity field values--major source of error in space inertial navigation systems.		
- (U) \$9,503	Began development of a Rocket System Launch Program launch capability using excess ballistic missile assets to test low-cost pop-up upperstage systems.		
- (U) \$49,667	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$4,723	Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.		
-	(U) Continue development of ultra-high efficiency four-junction photovoltaic and thermal electric cells.		
-	(U) Conduct in-house electrical characterization of Manufacturing Technology (ManTech) 24% efficient three-junction solar cell.		
-	(U) Establish interagency cooperative development of lithium ion battery technology for space vehicle applications.		
-	(U) Continue development of lightweight flywheel integrated power and attitude control systems (IPACS); goal is seven-fold decrease in subsystem weight.		
-	(U) Continue cryocooler reliability improvement initiatives and begin development of improved cryocooler models and simulation software.		
-	(U) Continue development of enhanced capillary pumped loop/looped heat pipe thermal management systems and design cryogenic capillary pumped loop/looped heat pipe system for cryogenic sensor integration.		
- (U) \$4,017	Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.		
-	(U) Continue the advanced adaptive structures technology development program.		
-	(U) Continue launch vibration isolation program.		
-	(U) Initiate miniature isolation system program.		
-	(U) Continue development of multifunctional spacecraft structures.		
-	(U) Continue space-based radar structures program.		
-	(U) Continue development of lightweight launch vehicle structure technologies.		

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2 - Applied Research

PE NUMBER AND TITLE

0602601F Phillips Laboratory Exploratory Development

PROJECT

8809

- (U) \$2,186

Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications.

- (U) Investigate suitability of long wavelength quantum well infrared photodetector technology for space-based surveillance systems.
- (U) Begin analysis and development of alternative technologies (e.g., antenna design) for low altitude space-based radar systems.

- (U) \$3,862

Develop technologies for space-based payload components such as hardened electronics and memories.

- (U) Continue evaluation and fabrication of advanced packaging technology whose goal is a 90% reduction in size/volume/weight.
- (U) Identify methods and techniques for exploiting commercial electronic advancements to develop low-power, high-performance, radiation-hardened devices and circuits for DoD space programs
- (U) Evaluate suitability of micro-electro-mechanical technologies for use in space-based systems.

- (U) \$2,601

Develop technologies for satellite control, astrodynamics, modeling and simulation, and autonomous operations.

- (U) Complete development of satellite control software for applications such as multi-mission advanced ground intelligent control.
- (U) Continue development of next generation astrodynamics models for orbit determination and collision risk assessment.
- (U) Continue development of simulation architecture for space-based surveillance models for wargaming, training, and concept of operations (CONOPS).
- (U) Determine requirements for software for distributed networks for battlespace observation, and data collection, processing, and dissemination.

- (U) \$11,103

Develop ground and small satellite integration technologies for space and near-space experiments.

- (U) Launch MightySat I from Space Shuttle mission STS-88. Conduct flight operations. One year on-orbit will validate space applied research technologies minimizing the risk of inserting advanced technology into operational satellites.
- (U) Continue fabrication of MightySat II.1 spacecraft bus and begin integration of experiments for FY 2000 launch.
- (U) Begin integration of technologies manifested for MightySat II.2 which tentatively include autonomous navigation and control, autonomous decision-making, threat-warning component technologies, a flywheel energy storage device, and space-based space surveillance
- (U) Demonstrate the capability to dynamically control the position of a large aperture, sparse optical array via a fully integrated UltraLITE ground demonstration.
- (U) Continue the development of near-space capabilities and bus technologies for experiments requiring high altitudes and guided recovery systems.

Project 8809

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Exhibit R-2 (PE 0602601F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	8809	
- (U) \$1,289	Develop technologies such as guidance, navigation, and control avionics to support launch vehicles and ballistic missile flights.		
- (U) \$5,804	- (U) Complete improved techniques to determine accurate gravity field values, a major source of error in space inertial navigation systems.		
- (U) \$35,585	Conduct Phase III of the Terabit fiber optic technology program.		
	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$5,040	Develop technologies for space platform subsystems such as cryocoolers, space vehicle thermal management, compact solar power cells, lightweight batteries, and innovative power generation concepts.		
	- (U) Continue development of ultra-high efficiency four-junction photovoltaic and thermal electric cells.		
	- (U) Conduct in-house electrical characterization of 35-40% efficient four-junction solar cells.		
	- (U) Continue interagency cooperative development of lithium ion battery technology; integrate deliverable into flight experiment.		
	- (U) Initiate new integrated power chip program for microsatellites.		
	- (U) Begin development of electrochromic thermal coatings for advanced deployable thermal radiators.		
	- (U) Continue development and enhance cryocooler models and simulation software.		
- (U) \$5,137	Develop technologies for space platform structures such as spacecraft structural controls for vibration suppression and lightweight composite satellite and launch vehicle structures.		
	- (U) Complete the advanced adaptive structures technology development program.		
	- (U) Continue launch vibration isolation program.		
	- (U) Continue design efforts for the miniature isolation system program.		
	- (U) Initiate the autonomous active structural control program.		
	- (U) Initiate advanced gimbal program.		
	- (U) Continue development of multifunctional spacecraft structures.		
	- (U) Continue space-based radar structures program.		
- (U) \$2,041	Develop technologies for space-based payload subsystems such as hardened sensors and satellite communications.		
	- (U) Begin development of advanced infrared photodetectors (e.g., multi-spectral quantum wells) for space applications.		
	- (U) Continue analysis and development of alternative technologies (e.g., antenna design) for low altitude space-based radar systems.		

Project 8809

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Exhibit R-3 (PE 0602601F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602601F Phillips Laboratory Exploratory Development	8809	
- (U) \$3,955	Develop technologies for space-based payload components such as hardened electronics and memories.		
	- (U) Continue evaluation and fabrication of advanced packaging technology whose goal is 90% reduction in size/volume/weight.		
	- (U) Continue to identify methods and techniques for exploiting commercial electronic advancements to develop low-power, high-performance, radiation-hardened devices and circuits for DoD space programs.		
	- (U) Begin development of guidance and navigation components based on micro-electro-mechanical system (MEMS) technologies.		
- (U) \$3,273	Develop technologies for satellite control, astrodynamics, modeling and simulation, and autonomous operations.		
	- (U) Continue development of next generation astrodynamics models for orbit determination and collision risk assessment.		
	- (U) Continue development of simulation architecture for space-based surveillance models for wargaming, training, and concept of operations (CONOPs).		
	- (U) Design architecture and start development of software for distributed networks for battlespace observation, and data collection, processing, and dissemination.		
	- (U) Continue development of software for autonomous space technology products.		
- (U) \$11,673	Develop ground and small satellite integration technologies for space and near-space experiments.		
	- (U) Conclude MightySat I flight operations. Develop and distribute final report.		
	- (U) Complete fabrication of MightySat II.1. Complete payload integration and launch vehicle integration of MightySat II.1 to launch aboard Orbital-Suborbital Program launch vehicle in FY 2000.		
	- (U) Begin initial design of modifications to baseline MightySat II vehicle to accommodate experiments on autonomous navigation and control, autonomous decision-making, threat-warning component technologies, a flywheel energy storage device, and space-based space surveillance.		
	- (U) Develop microsatellite technologies in support of near-earth object inspection and asteroid fly-by mission.		
	- (U) Begin integration of the second integrated ground, hardware-in-the-loop demonstration which will demonstrate integrated spacecraft energy storage and attitude control.		
	- (U) Continue the development of near-space capabilities and bus technologies for experiments requiring high altitudes and guided recovery systems.		
- (U) \$31,119	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
2 - Applied Research		8809	
PE NUMBER AND TITLE		0602601F Phillips Laboratory Exploratory Development	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	53,513	28,469	31,263
	49,667	35,585	31,119
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0602203F, Aerospace Propulsion.			
- (U) PE 0602102F, Materials.			
- (U) PE 0603302F, Space and Missile Rocket Propulsion.			
- (U) PE 0603311F, Ballistic Missile Technology.			
- (U) PE 0603401F, Advanced Spacecraft Technology.			
- (U) PE 0603410F, Space Systems Environmental Interactions.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
2 - Applied Research		0602602F Conventional Munitions									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	39,222	38,505	41,529	42,826	45,556	46,243	47,536	Continuing	Continuing	
2068	Advanced Guidance Technology	13,502	14,095	16,925	16,188	17,202	17,399	17,829	Continuing	Continuing	
2502	Ordnance Technology	25,720	24,410	24,604	26,638	28,354	28,844	29,707	Continuing	Continuing	
	Quantity of RDT&E Articles	0	0	0	0		0	0	0	0	

Note: Beginning in FY 1998, Project 2543 has been combined with Project 2502. The total PE costs shown for FY 1997 reflect this consolidation.

(U) **A. Mission Description and Budget Item Justification:** This Applied Research program develops and establishes the feasibility of advanced technologies for conventional weapons. The program includes development of: (1) advanced guidance component technology for low-cost precision adverse-weather autonomous seekers; (2) advanced navigation/control technologies for advanced munitions; (3) fuze technology to reduce cost and increase supportability, safety, and performance; (4) affordable explosives for higher performance and lower sensitivity; (5) advanced analytical tools for calculating weapons effects to reduce development time and cost; (6) advanced weapon airframe (including highly agile control technology) and carriage technology; (7) advanced warhead development technologies and advanced kill mechanisms for target defeat; and (8) advanced analytical methods for predicting advanced weapons effectiveness.



## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE			
<b>2 - Applied Research</b>	<b>0602602F Conventional Munitions</b>			
(U) B. <u>Program Change Summary (\$ in Thousands):</u>				
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Appropriated Value	41,038	40,772	42,999	Cost
(U) Adjustments to Appropriated Value	42,573	40,772		Cont
a. Congressional/General Reductions	-952	-1,780		
b. SBIR	-509	-487		
c. Omnibus/Other Above Threshold Reprogrammings	-1,845			
d. Below Threshold Reprogrammings				
e. Rescissions	-45			
(U) Adjustments to Budget Year Since FY 1998 PB			-1,470	
(U) Current Budget Submit/FY 1999 PB	39,222	38,505	41,529	Cont
(U) Change Summary Explanation:				
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.				
Schedule: Not Applicable.				
Technical: Not Applicable.				
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.				
(U) D. <u>Schedule Profile:</u> Not Applicable.				

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
		February 1998

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602602F Conventional Munitions	2068

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
2068	Advanced Guidance Technology	13,502	14,095	16,925	16,188	17,202	17,399	17,829	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project develops precision terminal guidance technologies for air-launched conventional weapons and technologies for midcourse guidance for advanced munitions. Project payoffs include: adverse-weather and "launch and leave" precision guidance capability; increased number of kills per sortie; increased aircraft survivability; improved reliability and affordability; reduced test costs; shorter development programs; and improved survivability and effectiveness of conventional weapons.

- (U) \$7,926 Develop and demonstrate guidance component technology for low-cost, precision, adverse-weather capable, autonomous seekers.
- (U) Completed correlation filter development for laser radar (LADAR) sensors; continued development of optical correlator technologies (i.e., high-speed, high resolution, multiple state-capable correlator hardware).
- (U) Continued experiments on an adverse-weather, wide field-of-view, high resolution, passive, millimeter wave sensor for use in future covert seekers.
- (U) Completed design and initiated fabrication/integration of a conformal antenna array broadband seeker that provides an instantaneously accessible wide field-of-regard.
- (U) Completed construction of a multichannel LADAR broadband; utilized completed broadband to continue technology base development to enhance the capability of solid state LADAR (e.g., increase operating range, assess rapid scanning techniques, develop multichannel receiver capability, and develop longer wavelength technology).
- (U) Assessed promising target/background signature phenomenology to exploit for an advanced infrared (IR) imaging seeker.
- (U) Completed construction of broadband scene projector for solid state LADAR seekers.
- (U) Investigated sensor modeling techniques for an autonomous LADAR guidance system.
- (U) Developed LADAR algorithms for detecting, recognizing, and guiding seekers to high value targets in clutter and countermeasure environments.

**Develop and demonstrate advanced navigation/control technologies for advanced munitions.**

- (U) Completed breadboard assembly and laboratory testing; developed preliminary design for an advanced jam resistant Global Position System/Inertial Navigational System that is 40 percent of the size and cost of FY 1995 technology.
- (U) Completed fabrication of micro-machined inertial sensor and begin fabrication of a breadboard inertial measurement unit.

## Develop and demonstrate instrumentation for weapons guidance development and evaluation.

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Exhibit R-2 (PE 0602602F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 2 - Applied Research

## 0602602F Conventional Munitions

PROJECT

2068

- (U) Completed development of new subminiature telemetry chip-set functions and new packaging concepts for high-g usage.
- (U) Completed development of spectrally efficient modulation and coding methods for telemetering wideband test data.
- (U) \$13,502
- Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$8,821

Develop and demonstrate guidance component technology for low-cost, precision, adverse-weather capable, autonomous seekers.

- (U) Continue development of optical correlator technologies (i.e., high-speed, high resolution, multiple state-capable correlator hardware); provide filters to support optical processing enhanced laser radar experiments.

- (U) Conduct phenomenology analysis of high resolution, passive, millimeter wave target background imagery for use in future adverse weather wide field of view covert seekers.

- (U) Complete fabrication/integration of a conformal array seeker breadboard that provides an instantaneously accessible, wide field-of-regard.

- (U) Investigate laser radar (LADAR) techniques for penetrating adverse-weather; build and test a two-wavelength LADAR system; design/build a flightworthy LADAR modular brassboard seeker; and design a snapshot LADAR system.

- (U) Evaluate current technologies for developing affordable, passive, electro-optical/infrared seekers sensitive to infrared, multi-color, and polarization phenomena that will provide improved autonomous terminal seekers.

- (U) Develop sensor models for LADAR and passive millimeter wave (MMW) to assess target model fidelity impact.

- (U) Validate LADAR algorithms for detecting, recognizing and guiding on high value targets in a clutter and countermeasure environment.

- (U) Complete validation of a four-channel pixel-registered active/passive infrared (IR)/MMW synthetic scene generation code against range measured data.

- (U) \$4,653
- Develop and demonstrate advanced guidance technologies for advanced munitions.

- (U) Complete breadboard Antijam Global Positioning System/Inertial Navigation System (GPS/INS) fabrication and test; initiate design for a brassboard advanced Antijam GPS/INS that is 40 percent of the size and cost of FY 1995 technology.

- (U) Complete development, fabrication, and testing of the breadboard inertial measurement unit (IMU) system; initiate the design of the IMU system brassboard based on the breadboard IMU test results.

- (U) \$621
- Develop and demonstrate advanced control technologies for advanced munitions.

- (U) Develop weapons hardware-in-loop simulation software; initiate flight software development and test missile six Degree-Of-Freedom (DOF) simulation.

- (U) \$14,095
- Total

Project 2068

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Exhibit R-2 (PE 0602602F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602602F Conventional Munitions	2068	
(U) FY 1999 (\$ in Thousands):			
- (U) \$9,718	Develop and demonstrate guidance component technology for low-cost, precision, adverse-weather capable, autonomous seekers.		
-	(U) Complete optical filter development for the optical processing enhanced laser radar (LADAR) experiments; develop processing hardware technology for advanced sensors; and, develop accompanying advanced filter concepts to include ultra high-speed processors for miniature electro-optical and radio frequency imaging sensors.		
-	(U) Initiate design for fabrication and assembly of a passive millimeter wave (MMW) for a captive flight test imaging sensor.		
-	(U) Ground test a conformal antenna seeker breadboard that provides an instantaneously addressable wide field-of-regard.		
-	(U) Develop specifications for affordable, passive, electro-optical/infrared seekers sensitive to multi-color infrared and polarization phenomena to provide improved autonomous terminal seekers; determine applicability of advanced imaging infrared (IR) versus LADAR for endgame aimpoint selection and guidance integrated fuzing.		
-	(U) Utilize captive flight brassboard LADAR system for image collection and detecting occluded targets; test two-wavelength LADAR concept for detecting occluded targets; develop and fabricate a 1.06 micron snapshot LADAR system; assess frequency agile laser sources.		
-	(U) Develop a LADAR autonomous algorithm suite to identify mobile targets having articulated components.		
-	(U) Enhance baseline Modular Algorithm Concept Evaluation Tool (MACET) to include tracking/aimpoint selection algorithms, on-line help functions, improved signal/image processing functions and data fusion algorithms.		
-	(U) Initiate the design and development of an active/passive infrared air-to-air target/scene modeling capability to facilitate the design and testing of autonomous target acquisition algorithms.		
- (U) \$3,574	Develop and demonstrate advanced guidance technologies for advanced munitions.		
-	(U) Complete brassboard Antijam Global Positioning System/Inertial Navigation System (GPS/INS) design and begin fabrication of a brassboard GPS/INS that is highly jam resistant, affordable, and readily useable in future tactical weapons.		
- (U) \$3,633	(U) Complete development, fabrication, and testing of the inertial measurement unit system brassboard.		
-	Develop and demonstrate advanced control technologies for advanced munitions.		
-	(U) Complete development of a six Degree-Of-Freedom (DOF) simulation; that incorporates high fidelity wind tunnel and control system data; evaluate autopilot and guidance system performance with hardware-in-the-loop tests.		
- (U) \$16,925	Total		

Project 2068

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Exhibit R-2 (PE 0602602F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
2 - Applied Research		0602602F Conventional Munitions	2068
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		14,385	17,265
(U) Current Budget Submit/FY 1999 PB		13,502	16,925
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0603601F, Conventional Weapons Technology.			
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.			
- (U) PE 0604940D, Central Test and Evaluation Improvement Program.			
- (U) PE 0604604F, Submunitions Development.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998						
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT						
2 - Applied Research		0602602F Conventional Munitions		2502						
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2502	Ordnance Technology	25,720	24,410	24,604	26,638	28,354	28,844	29,707	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops technologies for advanced weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, and warheads for conventional weapons, and weapon airframe and carriage technology. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved non-nuclear warhead and fuze effectiveness; improved submunition dispensing; selectable multimode kill capability; low-cost airframe/subsystem components and structures; and reduced aircraft/weapons drag and radar signature. Assesses the lethality and effectiveness of current and planned conventional weapons technology programs, and assesses the vulnerability of targets against which conventional weapons are designed. Project payoffs include more thoroughly tested weapon systems and improved weapon lethality.

(U) **FY 1997 (\$ in Thousands):**

- (U) \$2,737 Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.
- (U) Fabricated and evaluated a proximity sensor for general purpose bomb fuzes; investigated implementations of high/low drag sensing methods.
- (U) Conducted preliminary design studies of a hard target penetrating radar fuze to optimize burst point selection.
- (U) Completed trade studies on an integrated ordnance package capable of defeating future air targets and surface-to-air missiles.
- (U) \$2,083 Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
- (U) Conducted initial explosive experiments to provide low-cost technologies for demilitarization of weapon explosives.
- (U) Continued sensitivity experiments of insensitive explosive fills which survive hard target penetration while increasing blast performance.
- (U) \$1,323 Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
- (U) Validated explosive shock wave interaction simulation for developing advanced multimode warheads.
- (U) Defined methodology for incorporation of unstructured grid methods into penetrator weapon design tools.
- (U) Planned development of next generation weapon design methods for hard target warheads incorporating heavy metals.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602602F Conventional Munitions	2502	
- (U) \$4,515	Develop and demonstrate advanced weapon airframe and carriage technology for advanced munitions.		
	- (U) Developed flight control software and simulations for a highly maneuverable weapon incorporating hybrid reaction jet/aerodynamic flight controls.		
- (U) \$6,753	- (U) Continued development of initial system integration/design of a rapid response weapon for effectively engaging time-critical targets.		
	- (U) Completed fabrication of selected fin folding and deployment mechanisms for compressed carriage.		
- (U) \$3,026	- (U) Continued installation of high resolution solid state, digital shadow-graph system to allow for quick and less expensive data collection, processing, and analysis to reduce time to evaluate projectile configurations.		
	- (U) Completed experiments for coupling electrical energy into targets using antimateriel warhead.		
- (U) \$2,163	- (U) Performed subscale tests of advanced penetrator warhead materials for high velocity penetration.		
	- (U) Completed weapons effects holography program; transition technology to munition development facilities.		
- (U) \$1,683	- (U) Fabricated and tested brassboard automated holographic data reduction system to provide improved warhead hydrocode test data.		
	- (U) Integrated and laboratory tested high-speed, high resolution electronic imager.		
- (U) \$1,683	Develop and extend Modular Effectiveness Vulnerability Assessment (MEVA) code to increase accuracy of weapon effectiveness predictions against fixed hardened targets.		
	- (U) Continued MEVA code configuration management activities to ensure software changes are authorized, validated, documented, and distributed to user community; weapons combined effects software module completed.		
- (U) \$1,683	- (U) Continued component vulnerability experiments, developed first set of fragility algorithms for integration in MEVA code, and completed code validation experiments.		
	- (U) Developed algorithms and new functional modules for integration into MEVA to accurately predict the effectiveness of advanced munitions technology concepts.		
- (U) \$1,683	- (U) Completed development/integration of systems level lethality/vulnerability assessment methodologies into MEVA for buried/hardened targets, above ground structures, tunnels, linear targets, and weapons of mass destruction.		
	Develop and demonstrate analytical methods of predicting weapon effectiveness and the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness.		
- (U) \$1,683	- (U) Completed development of weapon assessment methodologies that significantly reduce requirements for expensive lethality/vulnerability data collection experiments.		
	- (U) Conducted initial phenomenology and weapon effects experiments to provide data for code deficiencies with respect to advanced munition concepts.		

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Exhibit R-2 (PE 0602602F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602602F Conventional Munitions	2502	
	- (U) Conducted experiments and analyses to investigate phenomena such as synergistic effects from blast and fragments, simultaneous detonations, and penetration dynamics through rock, rubble, and geological material of various hardness.		
- (U) \$645	Develop and demonstrate advanced weapons analytical methodologies.		
	- (U) Validated antimateriel submunition analyses versus actual warhead arena and flight test data.		
	- (U) Enhanced and developed codes for hard target penetration and weapons of mass destruction munition technologies.		
	- (U) Developed joint compatible models to allow evaluation of synthetic aperture radar seeker technology and infrared seeker technology in support of munition tools to make evaluation of munition performance with new technology a much faster, cheaper, and more effective process.		
- (U) \$792	Develop and demonstrate advanced munitions seeker analyses capability.		
	- (U) Continued to validate four-channel pixel-registered active/passive infrared/millimeter wave (IR/MMW) synthetic scene generation code against measured data.		
- (U) \$25,720	- (U) Completed development of six-channel pixel-registered active/passive IR/MMW, visible, ultraviolet synthetic scene generation code.		
	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602602F Conventional Munitions	2502	
(U) FY 1998 (\$ in Thousands):			
- (U) \$4,433	Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.		
-	(U) Develop a computer simulation of the multipoint initiation system electrical power distribution to support development of future multipoint initiated weapons.		
-	(U) Develop analysis and test methodology to simulate loads equivalent to 2,500 feet/second impact velocity; develop methods to simulate full-scale body response in fuzes using 1/4 scale test procedures and analyses.		
-	(U) Complete ground target clutter generator modification for target simulator.		
-	(U) Complete design studies for a combined target detection device/warhead unit; conduct modeling and simulation of the Target Detection Device to establish optical and image processing algorithm performance; complete warhead fragmentation and lethality assessment to ensure technological feasibility of design; fabricate and arena test warheads to confirm engineering design and warhead models.		
- (U) \$2,015	(U) Complete fabrication and testing of advanced millimeter wave integrated circuit radio frequency proximity sensors. Develop and demonstrate affordable explosives for higher performance and lower sensitivity.		
-	(U) Perform reclamation experiments on inventory explosives to determine best methods for recovering/disposing of explosives.		
-	(U) Develop technologies for non-shock initiation of explosives during penetration of hard targets.		
-	(U) Reevaluate sensitivity of CL20 composite explosives; test sensitivity and performance of melt castable and cast cure composite explosives.		
- (U) \$2,359	Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.		
-	(U) Complete development of warhead/target interaction models for hard target penetrating weapons.		
-	(U) Complete parallelization and supercomputer rehosting of design code for penetrating weapons		
-	(U) Complete assessment of capability to simulate high-speed, hard target, penetration weapons.		
-	(U) Develop and demonstrate advanced analytical tools for calculating weapon effects that will reduce development time and cost.		
- (U) \$3,249	Develop and demonstrate advanced weapon airframe and carriage technology for advanced munitions.		
-	(U) Demonstrate through wind tunnel and radar cross section testing the ability to carry large loadouts of innovative compressed weapons in a low-drag and survivable manner on tactical aircraft.		
-	(U) Refine the initial design of a rapid response weapon for effectively engaging time-critical targets; develop design guidelines for applying the most promising technologies in future time-critical target weapons.		

Project 2502

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Exhibit R-2 (PE 0602602F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602602F Conventional Munitions

2502

- (U) \$5,088 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for target defeat.
  - (U) Validate detonation shock dynamics code capability against highly instrumented range experiments.
  - (U) Assess tantalum materials for application to multimode warheads.
  - (U) Evaluate performance of thermite systems for enhanced lethality.
  - (U) Initiate explosive survivability modeling and testing.
  - (U) Characterize advanced casing and high explosive materials for structural survivability and enhanced target defeat.
  - (U) Perform technology and system trade studies on very high-speed penetrators.
- (U) \$3,065 Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets.
  - (U) Utilize tunnel defeat test data to incorporate a tunnel vulnerability module into MEVA architecture; implement configuration management of MEVA to ensure software changes are authorized, validated, documented, and distributed to user community.
  - (U) Conduct component vulnerability experiments against target power generation/distribution, air handling and fuel pump equipment to support develop of corresponding fragility algorithms for incorporation into the MEVA architecture.
  - (U) Complete vectorization/code enhancements to speed development of weapon effectiveness assessments and parametric trade studies utilizing distributed processing.
- (U) \$3,055 Develop and demonstrate analytical methods of predicting weapon effectiveness and characterize the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness.
  - (U) Conduct hypersonic penetration experiments into weathered granite using advanced munition concepts; develop a physics-based engineering module for predicting weapon effectiveness against geologic targets.
  - (U) Integrate synergistic effects damage modules into the MEVA architecture to accurately predict the lethality of advanced munitions concepts against brick and concrete masonry walls.
- (U) \$1,146 Develop and demonstrate advanced weapons analytical methodologies.
  - (U) Develop signal processing/jammer model simulations for the anti-jam Global Positioning System technology, and perform analyses for development and risk reduction on flight tests.
  - (U) Upgrade low-cost autonomous attack submunition six-degree-of-freedom simulations to perform assessments for the anti-materiel munition integrating concept including preflight and postflight test risk reduction; conduct trade study to enable technology development planning.
  - (U) Provide six-degree-of-freedom missile simulation and subsystem component simulations for weapon technology development concepts.
  - (U) Provide concept trade studies for hard target munition integrating concept technologies; develop a detailed six-degree-of-freedom simulations for a boosted hard target penetrator.
- (U) \$24,410 Total

Project 2502

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Exhibit R-2 (PE 0602602F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
2502  
0602602F Conventional Munitions

## 2 - Applied Research

(U) FY 1999 (\$ in Thousands):

- (U) \$4,004 Develop and demonstrate fuze technology to reduce cost and increase supportability, safety, and performance.
- (U) Develop advanced single and multi-point initiation systems which will provide increased weapon flexibility and effectiveness.
- (U) Develop analyses and test methodologies necessary to simulate loads equivalent to 3,000 feet/second impact velocity. Analyses full-scale body responses in fuzes using 1/4 scale test methodology.
- (U) Fabricate, test, and transition an electronic countermeasures-hardened proximity fuze.
- (U) Complete design of a digitally driven radio frequency signal generator for proximity fuze applications.
- (U) Develop and demonstrate affordable explosives for higher performance and lower sensitivity.
- (U) Complete protocol test development to determine the probability of survivability of an explosive during a penetration event.
- (U) Continue evaluation of castable high performance explosives.
- (U) Test and evaluate high density explosives in a high impact environment.
- (U) Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
- (U) Develop and demonstrate advanced analytical tools for calculating weapons effects to reduce development time and cost.
- (U) Develop and demonstrate advanced weapon airframe and carriage technology for advanced munitions.
- (U) Integrate innovative compressed wing designs for advanced small munitions to extend the range of weapons without sacrificing weapon loadout on aircraft.
- (U) Develop initial designs of a flight demonstration vehicle utilizing the information developed under the time-critical target technology program.
- (U) \$5,946 Develop and demonstrate advanced warhead development technologies and advanced kill mechanisms for target defeat.
- (U) Perform tests of antimateriel warhead design with high performance insensitive explosives.
- (U) Develop tantalum liner materials for inclusion in antimateriel submunition warhead technology integrated design package.
- (U) Complete testing of mechanically induced combustion of energetic materials used in penetrating weapons.
- (U) Continue evaluate fuze energy storage systems.
- (U) Conduct advanced warhead casing and high explosive materials testing for structural survivability and enhanced target defeat.
- (U) Complete initial technology and trade studies and develop two programs to demonstrate enabling very high-speed penetrator technologies.

Project 2502

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Exhibit R-2 (PE 0602602F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602602F Conventional Munitions

PROJECT

2502

- (U) \$3,054

Develop and extend modular effectiveness vulnerability assessment code (MEVA) to increase accuracy of weapon effectiveness predictions against fixed hardened targets.

- (U) Incorporate chemical/biological agent release module into MEVA architecture; conduct configuration management of MEVA to ensure software changes are authorized, validated, documented, and distributed to user community.
- (U) Develop new computational modules and integrate into the MEVA architecture to accurately predict the effectiveness of advanced weapon concepts against targets containing chemical and/or biological materiel.
- (U) Collect and analyze advanced penetrator performance data against rock, rock rubble, and limestone geologic media to support the development of modularized, physics-based engineering algorithms for tunnel closure weapon effectiveness predictions.
- (U) Conduct component vulnerability experiments on weaponized munitions and storage vessels containing chemical/biological agents and develop corresponding fragility algorithms for the release of toxic material due to conventional damage mechanisms (blast and fragmentation).

- (U) \$3,011

Develop and demonstrate analytical methods of predicting weapon effectiveness and the coupling of destructive energy into the target, and the means to translate that information into advanced analytical methods for predicting weapon effectiveness.

- (U) Complete phenomenology and weapon effects experiments to provide code validation data for heavy metal munition lethality algorithms.
- (U) Conduct phenomenology and weapon effects experiments to provide data for code deficiencies with respect to hypersonic weapon penetration mechanics.
- (U) Develop physics-based modeling techniques with high-speed distributed and parallel processing computer architectures to reduce new weapon research and development experimental requirements.

- (U) \$1,215

Develop and demonstrate advanced weapons analytical methodologies.

- (U) Provide post-flight test analysis for the anti-jam Global Positioning System (GPS) technology, and refine anti-jam detailed six-degree-of-freedom to include system improvements like differential GPS, additional jammer threats, and GPS constellation/operational changes.
- (U) Perform pre-flight analysis for the anti-materiel munition integrating concept control flight tests and cable drop tests; provide performance estimates for powered low-cost anti-armor submunition enabling test planning and technology transition analyses.
- Extend six Degree-Of-Freedom (DOF) simulation models and conduct seeker, fuze, and guidance/control system assessments for high agility weapons.

- Continue support of the counterproliferation weapon technology development; accomplish detailed effectiveness analyses for technology selection/refinement based on new six Degree-Of-Freedom (DOF) flyout and lethality data for hard target munitions.

- (U) \$24,604 Total

Project 2502

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Exhibit R-2 (PE 0602602F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>2 - Applied Research</b>	<b>0602602F Conventional Munitions</b>	<b>2502</b>	
(U) <b>B. Program Change Summary (\$ in Thousands):</b>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	26,653	25,747	25,734
	25,720	24,410	24,604
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) <b>C. Other Program Funding Summary:</b>			
(U) Related Activities:			
- (U) PE 0603601F, Conventional Weapons Technology.			
- (U) PE 0604314F, Advanced Medium Range Air-to-Air Missile.			
- (U) PE 0604602F, Armament Ordnance Development.			
- (U) PE 0604604F, Submunitions Development.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) <b>D. Schedule Profile:</b> Not Applicable.			

UNCLASSIFIED

PE NUMBER: 0602702F

UNCLASSIFIED

PE TITLE: Command,Control, and Communication (C3)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
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BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602702F Command,Control, and Communication  
(C3)

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	90,590	84,545	65,175	54,146	52,826	53,374	55,152	Continuing	Continuing
2338 Reliability Sciences Technology	10,525	8,235	0	0	0	0	0	0	Continuing
4506 Surveillance Technology	15,890	14,858	11,772	9,125	9,555	9,716	9,997	Continuing	Continuing
4519 Communications Technology	11,846	11,037	12,381	10,626	12,045	11,574	11,814	Continuing	Continuing
4594 Information Technology	12,535	14,896	7,619	8,680	6,791	6,820	6,939	Continuing	Continuing
4600 Electromagnetic Technology	23,902	20,125	13,616	7,172	4,805	4,754	4,896	Continuing	Continuing
5581 Command and Control (C2) Technology	15,892	15,394	19,787	18,543	19,630	20,510	21,506	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Applied Research program is the primary source of new concepts, feasibility demonstrations, and advanced technology for Air Force Command, Control, and Communications (C3). Current developments include: increasing operational availability of C3 systems through improving reliability, diagnostic capability, and electromagnetic environmental performance; improving effectiveness and survivability through secure communications; improving surveillance range and detection capabilities against low-observable threats and enemy electronic countermeasures; and improving the timeliness and quality of data acquisition for decision making. The program addresses six technology areas: reliability sciences; surveillance; communications; information; electromagnetics; and command and control. Note: Decrease in FY 1999 and out is due to elimination of Project 2338, Reliability Sciences Technology.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 2 - Applied Research

PE NUMBER AND TITLE

0602702F Command, Control, and Communication  
(C3)(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	93,215	86,067	84,537	
(U) Appropriated Value	96,615	88,567		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-2,052	-2,978		
b. SBIR	-1,082	-1,044		
c. Omnibus/Other Above Threshold Reprogrammings	-2,789			
d. Below Threshold Reprogrammings				
e. Rescissions	-102			
(U) Other Adjustments to Budget Years Since FY 1998 PB			-19,362	
(U) Current Budget Submit/FY 1999 PB	90,590	84,545	65,175	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

2 - Applied Research

0602702F Command, Control, and Communication

PROJECT

2338

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2338	Reliability Sciences Technology	10,525	8,235	0	0	0	0	0	0	Continuing

(U) A. **Mission Description and Budget Item Justification:** The Air Force requires technology which increases reliability and diagnostic capability for electronic devices and systems while assessing electromagnetic environmental performance. Payoffs are increased system availability and lower life cycle costs. This effort focuses on technology to identify and eliminate design and fabrication characteristics that result in poor reliability. It develops equipment and system reliability and diagnostic techniques to be applied in development of military systems with improved operational readiness and supportability. Areas of emphasis include electronic technology reliability assessment, diagnostic development and integration, design for reliability, and system design and operational assurance.

## (U) FY 1997 (\$ in Thousands):

- (U) \$3,440 Developed electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
- (U) Assessed the quality, reliability, and electromagnetic effects performance of advanced electronic packaging concepts.
- (U) Defined performance of advanced microelectronics devices and measure their potential for system applications.
- (U) Assessed electromagnetic performance and reliability of microwave/millimeter-wave and optoelectronic devices for future systems.
- (U) \$3,385 Developed diagnostics technologies and integrated them into existing tools and techniques to address high-priority user requirements.
- (U) Developed design techniques that integrate computer-aided design with insertion of established built-in test modules.
- (U) Developed electromagnetic analysis and measurement tools to predict susceptibility thresholds and radio frequency performance in operational environments.
- (U) \$3,700 Developed reliability system design process enhancements to create tools, techniques, and guidelines to improve Command, Control, and Communications (C3) devices.
- (U) Demonstrated improved systems reliability by characterizing the electrical, electromagnetic, and mechanical stress-inducing parameters of the aerospace operational environment.
- (U) Developed computer-based reliability and maintainability tools and techniques for design of electronic circuits, devices, and systems.
- (U) \$10,525 Total

Project 2338

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602702F Command, Control, and Communication (C3)</b>	PROJECT <b>2338</b>

  

(U) FY 1998 (\$ in Thousands):

- (U) \$2,710 Develop electronic reliability techniques to evaluate new devices in an operational environment and recommend corrective action.
- (U) Develop a benchmark reliability and performance database on electronic devices in diverse environments for use in reliability prediction computer-aided design tools and techniques.
- (U) Demonstrate the performance of advanced microelectronics devices and their applicability for military systems.
- (U) Evaluate electromagnetic performance and reliability of microwave/millimeter-wave and optoelectronic devices for future systems.
- (U) \$2,600 Develop diagnostics technologies and integrate them into existing tools and techniques to address high-priority user requirements.
- (U) Conduct detailed designs for techniques that integrate computer-aided design with insertion of established built-in test modules.
- (U) Demonstrate electromagnetic analysis and measurement tools to predict susceptibility thresholds and radio frequency performance in operational environments.
- (U) \$2,925 Develop reliability system design process enhancements to create tools, techniques, and guidelines to improve Command, Control, and Communications (C3) devices.
- (U) Develop integrated and miniaturized multiparameter environmental smart sensors, utilizing micro-electro-mechanical systems technology, which can be applied to military systems such as unmanned aerial vehicles to help support information operations requirements, logistics requirements, and system health monitoring requirements.
- (U) Demonstrate computer-based reliability and maintainability tools and techniques for design of electronic circuits, devices, and systems.
- (U) \$8,235 Total

(U) FY 1999: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

2338

(C3)

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	10,537	8,619	5,697	Cost
(U) Current Budget Submit/FY 1999 PB	10,525	8,235	0	Cont
				TBD

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program. In FY 1999, this project has been eliminated.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program.
- (U) PE 0708026F, Producibility, Reliability, Availability, and Maintainability.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 2338

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Exhibit R-2 (PE 0602702F)

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE							
BUDGET ACTIVITY		PROJECT							
2 - Applied Research		February 1998							
PE NUMBER AND TITLE		PROJECT							
0602702F Command, Control, and Communication (C3)		4506							
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4506 Surveillance Technology	15,890	14,858	11,772	9,125	9,555	9,716	9,997	Continuing	Continuing
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> The Air Force requires advanced surveillance technologies to improve the performance and reduce the cost of Air Force surveillance systems. Major Applied Research areas of interest include: low-observable surveillance; passive surveillance; and advanced processing technologies. Technologies being developed include: advanced passive bistatic radar; spatial coordinate and time processing techniques; sensor and data fusion; signal generation; and advanced array antennas.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$5,795 Developed, tested, and demonstrated processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.</li> <li>- (U) Developed knowledge-based adaptive processing for bistatic ground-to-air radar applications.</li> <li>- (U) Completed Phase 2 of the multi-chip module wafer scale signal processor with a capability to perform twenty billion operations per second.</li> <li>- (U) Evaluated embedded parallel processing architecture for integrating wafer scale signal processor chips for a real-time signal processor enhancement demonstration.</li> <li>- (U) Developed technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.</li> <li>- (U) Conducted a design evaluation of the advanced airborne radar technology demonstration.</li> <li>- (U) Completed data collection, hardware integration, and software development for the static wing testbed; conducted ground-based field test.</li> <li>- (U) Conducted extensive field tests and demonstrations using integrated electronic support measures and bistatic passive surveillance and imaging technology on board a small aircraft; enhanced integrated passive surveillance and imaging technology capabilities through an airborne demonstration with a very broad frequency bandwidth controlled phase array.</li> <li>- (U) Developed special purpose artificial intelligence machines for both "expert" and "blackboard" systems.</li> <li>- (U) Developed and demonstrated graphical user interface software and platform-based displays; analyzed, tested, and demonstrated integrated knowledge-based fusion concepts.</li> </ul> <p>- (U) \$2,660</p>									

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>2 - Applied Research</b>	PE NUMBER AND TITLE <b>0602702F Command, Control, and Communication (C3)</b>	PROJECT <b>4506</b>

  

<p>– (U) \$975</p> <p>– (U) \$15,890</p> <p>– (U) \$2,753</p>	<p>Designed, developed, and tested ultrahigh fidelity microwave electronics for radar applications.</p> <ul style="list-style-type: none"> <li>– (U) Demonstrated optically-based increased dynamic range radar array emulation hardware for test and evaluation of microwave components.</li> <li>– (U) Developed high fidelity power conditioning system for active radar apertures.</li> <li>– (U) Incorporated digital preprocessing in the development of transmit and receive module technology for ground-to-air radar.</li> </ul> <p>Total</p>
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(U) FY 1998 (\$ in Thousands):

<p>– (U) \$6,110</p> <p>– (U) \$5,345</p>	<p>Develop, test, and demonstrate processing technologies and algorithms to enhance small target detection in a complex electromagnetic background.</p> <ul style="list-style-type: none"> <li>– (U) Demonstrate operational algorithm suites on embedded high performance computers.</li> <li>– (U) Evaluate and assess aircraft interaction algorithms for spatial coordinate and time adaptive processing.</li> <li>– (U) Continue development of multi-chip module wafer scale signal processor with a capability to perform twenty billion operations per second.</li> </ul> <p>Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.</p> <ul style="list-style-type: none"> <li>– (U) Conduct initial advanced airborne surveillance program demonstration tests.</li> <li>– (U) Complete ground-based field tests using the static wing testbed. Analyze effects of aircraft interactions on antenna sidelobe performance. Determine 64-channel receiver data degrees-of-freedom figure-of-merit baseline. Initiate transition of ground testbed to airborne bistatic testbed environment.</li> <li>– (U) Continue integrated electronic support measures and bistatic passive surveillance and imaging technology testing on board a small aircraft using a very broad frequency bandwidth phased array antenna. Initiate technology transition to unmanned aerial vehicle applications.</li> </ul>
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<p>– (U) \$2,753</p>	<p>Develop, test, and demonstrate advanced multispectral/multisensor fusion techniques for enhanced target detection and tracking.</p> <ul style="list-style-type: none"> <li>– (U) Demonstrate and assess special purpose artificial intelligence machines for both “expert” and “blackboard” systems.</li> <li>– (U) Continue development and demonstration of advanced graphical user interface software and platform based displays; analyze, test, and demonstrate integrated knowledge-based fusion concepts.</li> </ul>
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602702F Command, Control, and Communication (C3)	4506	
- (U) \$650	Design, develop, and test ultrahigh fidelity microwave electronics for radar applications.		
- (U) \$14,858	- (U) Complete development of optically-based increased dynamic range radar array emulation hardware for test and evaluation of microwave components.		
	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,867	Develop and demonstrate the ability to accurately determine sensor performance from airborne and space based platforms in realistic operational scenarios.		
	- (U) Incorporate advanced detection and tracking algorithms into existing signal processing capabilities and augment capabilities by including advanced jammer and jammer mitigation techniques.		
	- (U) Develop the capability to support sensors such as Joint Surveillance Target Attack Radar System (STARS) by including Synthetic Aperture Radar (SAR) Moving Target Indicator (MTI) capabilities into space- and time-adaptive processing.		
- (U) \$5,762	Develop technologies and concepts for passive surveillance with emphasis on electronic support measures and bistatics for enhanced detection, track, and classification in severe clutter and jamming environments.		
	- (U) Develop enhanced target detection capabilities through adaptive processing of innovative bistatic waveform designs.		
	- (U) Continue the advanced airborne surveillance program demonstration tests.		
	- (U) Transition ground testbed results to airborne bistatic testbed environment.		
	- (U) Continue integrated electronic support measures and bistatic passive surveillance and imaging technology testing and transition technology to unmanned aerial vehicle applications.		
- (U) \$4,143	Develop, test, and demonstrate advanced multispectral and multisensor fusion techniques for enhanced target detection and tracking.		
	- (U) Complete development and demonstration of advanced graphical user interface software and platform based displays; transition multiple integrated fusion algorithms to multi-platform applications.		
	- (U) Develop real-time sensor resource management and multispectral fusion techniques.		
- (U) \$11,772	- (U) Develop power efficient advanced computing architectures for real-time fusion and detection processing		
	Total		

Project 4506

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Exhibit R-2 (PE 0602702F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4506

(C3)

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	16,308	15,562	15,349	Cost
(U) Current Budget Submit/FY 1999 PB	15,890	14,858	11,772	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603726F, C3 Subsystems Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 4506

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602702F Command, Control, and Communication (C3)								4519	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4519	Communications Technology	11,846	11,037	12,381	10,626	12,045	11,574	11,814	Continuing	Continuing	
<p><b>(U) A. Mission Description and Budget Item Justification:</b> The Air Force requires technologies which will provide worldwide communications. The rapid build-up of U.S. presence abroad, via rapid application of air power, requires assured connectivity providing reliable, responsive, affordable transfer of information using all available communications media. This program provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques, such as spread spectrum and adaptive null steering; lightweight antennas and phased array antennas; and modular, programmable, low-cost radios and Command, Control, and Communications (C3) across the electromagnetic and optical spectrums. It includes technologies for advanced processors and devices, advanced network protocols, artificial intelligent communications management and control, advanced algorithms, and enabling processing techniques.</p> <p><b>(U) FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$3,680 Developed critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.</li> <li>- (U) Developed and demonstrated on-demand multiple access, packet switching, imagery compression, and reachback technologies.</li> <li>- (U) Designed reduced weight, low-cost minimum-drag antenna solutions for airborne vehicle communications systems.</li> <li>- (U) Developed improved nulling algorithms, monolithic microwave integrated circuits, and packaging technologies for advanced ultra-high frequency (UHF) and super-high frequency (SHF) communications.</li> <li>- (U) Developed a joint Air Force/Army high capacity trunk radio for tactical mobile and fixed nodes.</li> <li>- (U) Investigated joint military use of personal communications systems.</li> <li>- (U) Developed technologies for improved security, survivability, timeliness, and reconstruction of communications networks.</li> <li>- (U) Demonstrated selected multiple access and asynchronous switching protocols for theater applications.</li> <li>- (U) Conducted initial demonstration of standards-based, interactive, secure user services which optimally employ the underlying commercially compatible communications network.</li> <li>- (U) Demonstrated intelligent, survivable network management that provides secure, system-wide optimization of resource usage.</li> </ul> <p>- (U) \$5,776</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
2 - Applied Research	0602702F Command, Control, and Communication (C3)	February 1998	4519
- (U) \$2,390	Developed advanced electronic and photonic processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.		
- (U) \$11,846	<ul style="list-style-type: none"> <li>- (U) Developed specifications for the next generation smart networking radio, incorporating proven smart adaptive signal processing multiple access and networking technologies.</li> <li>- (U) Developed and demonstrated potentially high payoff communications signal processing technologies applicable to future smart radio systems.</li> </ul>		
- (U) \$3,440	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$5,275	Develop critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide survivable radios and transceivers.		
- (U) \$2,322	<ul style="list-style-type: none"> <li>- (U) Develop high frequency and super-high frequency on-board packet switching, advanced communications protocols, imagery and video transmission, and reachback technologies.</li> <li>- (U) Develop reduced weight, low-cost, minimum-drag subsystems for air vehicle communications systems.</li> <li>- (U) Design and breadboard improved nulling algorithms, monolithic microwave integrated circuits, and crosslink and packaging technology for satellite and unmanned aerial vehicle platforms.</li> <li>- (U) Demonstrate fixed high capacity trunk radio with the Army.</li> <li>- (U) Specify required improvements to personal communications systems for military use.</li> </ul>		
- (U) \$11,037	Develop technologies for improved security, survivability, timeliness, and reconstruction of communications networks.		
- (U) \$2,390	<ul style="list-style-type: none"> <li>- (U) Develop intelligent interface or bridge between mobile wireless networks and wired/fiber network.</li> <li>- (U) Complete demonstration tests of standards-based, interactive, secure user services which optimally employ the underlying commercially compatible communications network.</li> <li>- (U) Demonstrate cooperation between network management entities to optimize information flow throughout the overall information system including a dynamic applications interface and user responsive security mechanisms.</li> <li>- (U) Demonstrate intelligent, survivable network management that provides secure, system-wide optimization of resource usage.</li> </ul>		
- (U) \$2,322	Develop advanced electronic and photonic processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.		
- (U) \$11,037	<ul style="list-style-type: none"> <li>- (U) Design, test, and evaluate smart networking radio subsystems.</li> <li>- (U) Develop and demonstrate new adaptive communications signal processing and control technologies.</li> </ul>		
- (U) \$11,037	Total		



## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4519

(C3)

(U) FY 1999 (\$ in Thousands):

- (U) \$3,460 Develop critical communications technologies employing programmable devices, processing technologies, and monolithic microwave integrated circuits to provide global connectivity to aerospace forces.
  - (U) Continue development of ultra-high frequency (UHF) and super-high frequency (SHF) on-board packet switching, advanced communications protocols, imagery and video transmission, and reachback technologies.
  - (U) Demonstrate reduced weight, low-cost, minimum-drag subsystems for air vehicle communications systems.
  - (U) Demonstrate highly efficient nulling algorithms, monolithic microwave integrated circuits, and packaging technologies for advanced spacecraft antennas.
  - (U) Conduct joint Air Force/Army demonstration of high capacity trunk radio.
  - (U) Initiate study to evaluate 94 Gigahertz (GHz) and 120 GHz solidstate power amplifier, frequency synthesizer, and related component technologies to exploit extremely-high frequency domain.
- (U) \$4,666 Develop assurance of services (i.e., high probability that needed links will be available) and universal transaction services (i.e., capability to process requests from a variety of different systems) technologies for improved security, survivability, timeliness, and reconstruction of communications networks.
  - (U) Demonstrate early intelligent interface capabilities between mobile wireless network and wired/fiber network.
  - (U) Augment cooperative network management system to include artificial intelligence-based control mechanisms.
  - (U) Demonstrate intelligent, survivable network management that provides secure, system-wide optimization of resource usage.
- (U) \$3,255 Develop advanced communications signal processors, advanced network protocol, advanced algorithms, and enabling processing technologies essential for survivable communications.
  - (U) Demonstrate initial smart networking radio and subsystems.
  - (U) Transition smart networking radio and associated technologies to advanced development.
- (U) \$1,000 Develop Defensive Information Warfare (IW) tools and technology to ensure information protection and security of Air Force Information Systems.
  - (U) Initiate development of computer pathology technology for malicious code analysis, development of tools to automate computer forensics data discovery and technology to handle encrypted environments.
  - (U) Initiate efforts to develop and collect a database of attack indicators for preemptive Defensive Information Warfare.
  - (U) Initiate development of Defensive Information Operations planning tools.
- (U) \$12,381 Total

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4519

(C3)

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	12,300	11,550	10,964	Cost
(U) Current Budget Submit/FY 1999 PB	11,846	11,037	12,381	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to increased emphasis on communications technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602702F Command, Control, and Communication (C3)								4594	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4594	Information Technology	12,535	14,896	7,619	8,680	6,791	6,820	6,939	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> The Air Force requires technologies which improve and automate capabilities to process, manage, generate, fuse, exploit, interpret, and disseminate timely information. This project: improves recording, storage, and retrieval of high data-rate, large volume data; pursues speech processing technologies for signal exploitation and exploiting unintentional emissions; develops technology for correlation and fusion of multisource data; develops natural language technologies that can read text and extract data of interest; develops tools and techniques to build tailorable architectures that scale command level information production systems down to the wing and squadron level; provides advanced processing techniques for receipt, correlation analysis, and display of target reports from advanced sensors; supports advanced weapon systems through the exploration of multispectral, multisource imagery; and provides advanced techniques for mapping, charting, and geodesy data processing.</p> <p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$7,900 Developed processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.</li> <li>- (U) Integrated three-dimensional memory, error correction algorithms, and optical device technologies to develop enhanced storage and retrieval devices with reduced size, weight, and power requirements at lower cost; evaluated the first generation erasable media.</li> <li>- (U) Developed processing algorithms to automatically sort and route large volumes of communication signals to assist information analysts.</li> <li>- (U) Developed techniques that pro-actively correlate active radar signals with processing of non-cooperative signal emanations to support the release of beyond-visual-range weapons against high confidence air targets.</li> <li>- (U) Incorporated counter information technologies into the model abstraction and advanced data display techniques to enhance the exploitation of electronic imagery/information.</li> <li>- (U) \$2,290 Developed advanced information data handling techniques to automatically extract event data and update databases for prediction purposes.</li> <li>- (U) Developed techniques to build intelligent, single point, multimedia databases to provide the warfighter global awareness.</li> <li>- (U) Developed analytical tools which exploit message processing techniques to extract multimedia information for concise, efficient display to the warfighter.</li> <li>- (U) Integrated techniques to configure and manage a scaleable distributed information computing environment.</li> </ul>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4594

(C3)

- (U) \$2,345 Developed sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Developed Phase 2 techniques to improve the methodology required to manage and query imagery databases.
  - (U) Developed information currency techniques and data consistency techniques to support combat imagery/information systems.
  - (U) Applied modeling techniques which exploit aircraft mission video data to satisfy battle damage assessment requirements.
  - (U) \$12,535 Total
- (U) FY 1998 (\$ in Thousands):
- (U) \$7,970 Develop processing technologies responsive to operational deficiencies by improving information timeliness, reliability, and accessibility.
  - (U) Demonstrate read only three-dimensional memory configurations with error correction to develop enhanced storage and retrieval devices with reduced size, weight, and power requirements at lower cost; develop and assess second generation erasable media.
  - (U) Complete processing algorithm development to automatically sort and route large volumes of communication signals to assist information analysts.
  - (U) Develop processing technologies to exploit non-cooperative target attributes to support high confidence air target identification, continue development of pro-active fusion model for abstraction and inference of target identifications, continue developing techniques to correlate active radar tracks with passive signal identification techniques, develop advanced techniques for non-cooperative target identifications through the exploitation of target emissions.
  - (U) Evaluate and assess first generation model abstraction and advanced data display techniques which incorporate counter information technologies to enhance the exploitation of electronic imagery/information.
  - (U) Develop information data handling techniques to automatically extract event data and update databases for prediction purposes.
  - (U) Integrate advanced techniques to build intelligent, single point, multimedia databases to provide the warfighter global awareness.
  - (U) Integrate analytical tools which exploit message processing techniques to extract multimedia information for concise, efficient display to the warfighter.
  - (U) Evaluate machine learning techniques to configure and manage a scaleable distributed information computing environment.
  - (U) Develop sensor exploitation techniques for faster and more efficient imaging to support targeting, planning, and mission execution.
  - (U) Evaluate and assess Phase 2 imagery data base query developmental capability.
  - (U) Integrate information currency techniques and data consistency techniques to support combat imagery/information systems.
  - (U) Integrate modeling techniques which exploit aircraft mission video data to satisfy battle damage assessment requirements.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602702F Command, Control, and Communication (C3)	4594	
- (U) \$2,390	Develop protein-based optical memories for high density mass storage systems of the future.		
- (U) \$1,880	Develop information exploitation capabilities for imagery and electromagnetic signals and transition the capability to command and control systems in direct support of global engagement for information superiority.		
- (U) \$1,914	Develop information warehousing, storage and retrieval technologies to provide timely warfighter access to a complete suite of Command, Control, Communications, Computers, and Intelligence information.		
- (U) \$1,865	Develop advanced technologies and approaches for the acquisition, analysis, and timely dissemination of intelligence information.		
- (U) \$7,619	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$2,390	Develop protein-based optical memories for high density mass storage systems of the future.		
- (U) \$1,880	Develop information exploitation capabilities for imagery and electromagnetic signals and transition the capability to command and control systems in direct support of global engagement for information superiority.		
- (U) \$1,914	Develop information warehousing, storage and retrieval technologies to provide timely warfighter access to a complete suite of Command, Control, Communications, Computers, and Intelligence information.		
- (U) \$1,865	Develop advanced technologies and approaches for the acquisition, analysis, and timely dissemination of intelligence information.		
- (U) \$7,619	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4594

(C3)

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	13,409	13,092	13,133	Cost
	12,535	14,896	7,619	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
2 - Applied Research		0602702F Command, Control, and Communication (C3)								4600	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4600 Electromagnetic Technology		23,902	20,125	13,616	7,172	4,805	4,754	4,896	Continuing	Continuing	
<p>(U) A. <b>Mission Description and Budget Item Justification:</b> This project consists of three subset technologies: electromagnetics; solid state sciences; and photonics. Future surveillance, communications, and imagery/information processing systems will require improved technology for the generation, control, processing, and radiation of electromagnetic and optical energy to reduce system cost, improve system sensitivity, and increase processing rates. Promising technologies for improving Command, Control, and Communications (C3) systems are electromagnetic propagation and scattering (from targets and clutter), and monolithic microwave and millimeter-wave integrated components and antennas. This project develops: a technology base for electronic and photonic devices and device materials for C3 systems; optical technology for electronic data processing and storage; real-time target recognition and high-speed fiber optic interconnects; and control techniques for large phased array antennas. It also characterizes phenomena for low-observable surveillance.</p> <p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$6,937 Developed electromagnetic technologies for advanced surveillance and communications systems applications.</li> <li>- (U) Conducted experimental assessment of techniques to improve bistatic signal-to-clutter ratios for low radar cross section target detection.</li> <li>- (U) Finalized algorithm and initiated hardware development for infrared small target spectral discriminator.</li> <li>- (U) \$5,945 Developed advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.</li> <li>- (U) Designed and fabricated brassboard, high-temperature transmit array; designed, fabricated, and tested monolithic low noise amplifier.</li> <li>- (U) Developed substrates for aluminum/gallium nitride for high-power, high temperature, and optoelectronic applications, using new crystal growth methods.</li> </ul>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

2 - Applied Research

PE NUMBER AND TITLE

0602702F Command, Control, and Communication

PROJECT

4600

(C3)

- (U) \$11,020 Developed photonic components and related materials for insertion into core Command, Control, and Communications (C3) programs.
  - (U) Implemented recursive tracking techniques for infrared focal plane arrays to exploit unique qualities of Schottky barrier technology.
  - (U) Developed optical sources, detectors, and modulators for high-speed analog fiber optic links.
  - (U) Developed 'smart' pixel optoelectronics technology for high-speed parallel signal processing.
  - (U) Conducted Phase I development of the ultra-high-speed multiple access testbed and associated components for unique switching architecture, radar processors, and communications protocols.
  - (U) Conducted Phase I development of unique photonic signal processor brassboards to demonstrate optical logic and optical neural networks.
  - (U) Demonstrated radio frequency optical beamforming and anti-jamming processors for radar and communication systems.
- (U) \$23,902 Total
- (U) FY 1998 (\$ in Thousands):
  - (U) \$6,010 Develop electromagnetic technologies for advanced surveillance and communications systems applications.
    - (U) Evaluate digital beamforming algorithms for multiple simultaneous beams; evaluate phased array correction algorithms; develop wide-bandwidth techniques for arrays of patch radiators; evaluate competing designs for coupling signals within multilayer antenna structures.
    - (U) Develop algorithms, based on bistatic adaptive polarimetry, to extract targets from clutter; develop propagation models for channel distortion on wideband communications and surveillance links.
  - (U) \$4,975 Develop advanced materials and components capable of higher processing speeds at reduced power levels for telecommunications and survivable server applications.
    - (U) Develop Generation II indium phosphide crystal growth apparatus based on experiment-based modeling and simulation.
    - (U) Develop nitride-based substrates for low-defect-density aluminum/gallium nitride films for high-power, high temperature, and optoelectronic applications.
    - (U) Evaluate low noise amplifier using strain free, high indium content channels on gallium arsenide; develop array techniques for evaluating photonically triggered, wide bandwidth microwave sources.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
2 - Applied Research	0602702F Command, Control, and Communication (C3)	4600	
- (U) \$9,140	Develop photonic components and related materials for insertion into core Command, Control, and Communications (C3) programs.		
- (U)	(U) Develop a multiband, infrared imaging spectrometer capable of creating two-dimensional infrared data on a high value target.		
- (U)	(U) Fabricate optical sources, detectors and modulators for high-speed analog fiber optic links.		
- (U)	(U) Fabricate 'smart' pixel optoelectronics technology for high-speed parallel signal processing.		
- (U)	(U) Conduct Phase 2 development of the ultra-high-speed multiple access testbed and associated components for unique switching architecture, radar processors, and communications protocols.		
- (U)	(U) Conduct Phase 2 development of unique photonic signal processor brassboards to demonstrate optical logic and optical neural networks.		
- (U)	(U) Integrate radio frequency optical beamforming and anti-jamming processors for radar and communication systems.		
- (U) \$20,125	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$4,700	Develop electromagnetic technologies for advanced surveillance and communications systems applications.		
- (U)	(U) Demonstrate digital beam nulling techniques and demonstrate new computer codes for predicting antenna performance.		
- (U)	(U) Evaluate new computer codes for fast and accurate prediction of the bistatic radar cross section of complex targets.		
- (U)	(U) Validate the use of advanced bistatic clutter models for long range detection of low observable airborne targets.		
- (U) \$1,175	Develop advanced electromagnetic materials and components capable of higher processing speeds for sensing and communications applications.		
- (U)	(U) Evaluate alloys of nitrides with arsenides and phosphides for microwave transmitters and space-based ultraviolet sensors.		
- (U)	(U) Demonstrate performance of 120 Ghz low noise amplifiers using optimized materials.		
- (U)	(U) Demonstrate three-dimensional, optically excited, antenna array.		
- (U) \$5,880	Develop photonic sub-systems and components for control and processing of both data and radio frequency signals		
- (U)	(U) Develop, integrate and test photonic sources, detectors, and modulators for high-speed radio frequency distribution systems.		
- (U)	(U) Complete fabrication of smart pixel optoelectronic components for high-speed parallel signal processing.		
- (U)	(U) Develop radio frequency photonic beamforming and anti-jamming processors.		
- (U)	(U) Investigate photonic analog-to-digital (A/D) converters.		
- (U)	(U) Develop photonic interconnection architectures for high performance computers.		
- (U) \$1,861	Develop advanced concepts for electromagnetic apertures.		
- (U)	(U) Investigate beam forming techniques for distributed and for conformal apertures.		
- (U)	(U) Research the feasibility of digital beam forming and light-weight arrays for distributed, wide-baseline satellite arrays.		
- (U) \$13,616	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

4600

(C3)

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	24,361	21,064	22,272	Cost
(U) Current Budget Submit/FY 1999 PB	23,902	20,125	13,616	Cont

## (U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to higher priorities within the Sciences and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) PE 0603789F, C3 Advanced Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE							
BUDGET ACTIVITY		PROJECT							
2 - Applied Research		5581							
PE NUMBER AND TITLE		0602702F Command, Control, and Communication							
(C3)									
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5581 Command and Control (C2) Technology	15,892	15,394	19,787	18,543	19,630	20,510	21,506	Continuing	Continuing
<p><b>(U) A. Mission Description and Budget Item Justification:</b> The Air Force requires Command and Control (C2) technologies which provide the next generation of weapon systems with improved processing and presentation of information for real-time battle management. Technologies being developed in this project will increase capability, quality, and reliability while reducing the cost of computer resources in C2 systems. Work in this project focuses on developing advanced C2 computer software systems capable of providing vast improvements in military decision making. It also develops software engineering analysis tools, software development methodologies, and software quality specification and assessment techniques. It develops technology for distributed systems, data bases, and fault tolerance mechanisms; and knowledge-based technologies, systems, and data bases.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$5,880 Developed intelligent information technologies for real-time battle management and C2 supporting time-critical air operations.</li> <li>- (U) Demonstrated integration of planning technology using autonomous software agents and mixed initiative scheduling toolbox.</li> <li>- (U) Developed and demonstrated dialog-based, man-machine integration planning task.</li> <li>- (U) Developed and demonstrated evaluation criteria for intelligent information systems.</li> <li>- (U) Developed software technologies to provide increased capability, quality, and reliability while reducing support cost.</li> <li>- (U) Developed Phase 1 of the high level requirements engineering language with scenario generation for the requirements engineering environment.</li> <li>- (U) Evaluated concept design approaches and visualization techniques for parallel processing systems, parallel object-oriented programming methods, and advanced techniques for real-time parallel processing analyses.</li> <li>- (U) Completed development of benchmarks for parallel processing software.</li> <li>- (U) Developed enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.</li> <li>- (U) Demonstrated asynchronous switching technology as a local interconnect mechanism for shared collaborative context workspace across a distributed computing environment.</li> <li>- (U) Demonstrated feasibility of an optical storage and retrieval mechanism for multimedia database management brassboard.</li> <li>- (U) Demonstrated feasibility application-based reconfiguration of multiple distributed computing clusters.</li> <li>- (U) \$15,892 Total</li> </ul>									

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>2 - Applied Research</b>	<b>0602702F Command, Control, and Communication</b> <b>(C3)</b>	<b>5581</b>	

  

(U) FY 1998 (\$ in Thousands):	
- (U) \$5,714	Develop intelligent information technologies for real-time battle management and command and control for time-critical air operations.
	- (U) Develop high performance computational mechanism for knowledge discovery/mining and information integration for massive knowledge-based systems.
	- (U) Develop fully autonomous planning technology for inclusion in software toolbox.
	- (U) Demonstrate full-dialog man-machine interface for integration into planning task.
	- (U) Apply evaluation criteria for high performance knowledge bases.
- (U) \$4,760	Develop software technologies to provide increased capability, quality, and reliability while reducing support cost.
	- (U) Continue development of the high level requirements engineering language with scenario generation for the requirements engineering environment and other advanced technologies for requirements elicitation, specification, and validation.
	- (U) Develop architecture-directed synthesis technology and demonstrate the formal synthesis of high assurance software.
	- (U) Develop technology to support modeling and analysis of evolvable software, including dynamic language support.
	- (U) Develop concept design approaches and visualization techniques for parallel processing systems, parallel object-oriented programming methods, and advanced techniques for real-time parallel processing analyses.
	- (U) Expand baseline set of benchmarks for parallel processing software to include provisions for real-time systems.
- (U) \$4,920	Develop enabling technology for distributed computing and database technology using cluster techniques to allow secure processing and management of multimedia information by commanders at all echelons.
	- (U) Evaluate asynchronous switching technology as a local interconnect mechanism for shared collaborative context workspace across a distributed computing environment.
	- (U) Evaluate utility of optical storage multimedia database management brassboard.
	- (U) Evaluate utility of application-based reconfiguration of multiple distributed computing clusters.
- (U) \$15,394	Total

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		<b>DATE</b> February 1998
<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>	<b>PE NUMBER AND TITLE</b> <b>0602702F Command, Control, and Communication (C3)</b>	<b>PROJECT</b> <b>5581</b>
<p>(U) FY 1999 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$7,278 Develop intelligent information technologies for real-time battle management and control for time-critical air operations.</li> <li>- (U) Demonstrate integration of planning technology for incremental plan refinement and synchronization of resources.</li> <li>- (U) Demonstrate high performance knowledge base technology for coordination, cooperation, and negotiation.</li> <li>- (U) Develop and demonstrate preplan-to-react planning technology for noncontinuous planning.</li> <li>- (U) Develop and demonstrate tools and techniques for collaborative intelligent systems including intelligent agents and knowledge bases.</li> <li>- (U) Develop software technologies to provide increased capability, quality, and reliability while reducing support cost.</li> <li>- (U) Complete development of high level requirements engineering language (i.e., methods to identify, document, track, and review user requirements) and scenario generation (i.e., creating test cases to ensure the requirements are accurate and complete).</li> <li>- (U) Continue development of architecture-centered technology that provides easier-to-design and easier-to-maintain software.</li> <li>- (U) Continue development of technology to support modeling and analysis of evolvable software, including dynamic language support.</li> <li>- (U) Develop distributed computing and database technology to enable secure processing and management of multimedia information, ensuring access by commanders at all echelons.</li> <li>- (U) Apply asynchronous switching technology to shared collaborative workspaces across a distributed computing environment.</li> <li>- (U) Integrate optical storage multimedia database management systems.</li> <li>- (U) Develop and demonstrate brassboard reconfiguration of multiple distributed sets of nodes for command and control systems.</li> <li>- (U) \$19,787 Total</li> </ul>		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

2 - Applied Research

0602702F Command, Control, and Communication

5581

(C3)

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	16,300	16,180	17,122	Cost
(U) Current Budget Submit/FY 1999 PB	15,892	15,394	19,787	Cont

## (U) Change Summary Explanation:

Funding: Changes in this project since the previous President's Budget are due to increased emphasis on command and control technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0603617F, C3 Applications.
- (U) PE 0603728F, Advanced Computing Technology.
- (U) PE 0603789F, C3 Advanced Development.
- (U) PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 5581

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Exhibit R-2 (PE 0602702F)

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PE NUMBER: 0602805F

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PE TITLE: Dual Use Applications Program (DUAP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998											
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT											
2 - Applied Research		0602805F Dual Use Applications Program (DUAP)								4770											
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost											
4770	Dual Use Science and Technology (S&T)	0	0	19,606	18,253	18,180	18,098	18,117	Continuing	Continuing											
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0											
<p><b>(U) A. Mission Description and Budget Item Justification:</b> This Applied Research program allows the Air Force to leverage industry investments in advanced technologies that are mutually advantageous to both the Air Force and industry. One of the program's goals is to incorporate dual use technology as part of the standard Air Force S&amp;T way of doing business. Cost sharing requires both industry and laboratory commitment to the development effort resulting in efforts that are both militarily relevant and commercially viable. Specific projects are determined through annual solicitation(s). Another goal is to utilize FY 1997 Defense Authorization Act Section 804, Other Transactions authority, as part of the Dual Use S&amp;T program in order to educate the Air Force S&amp;T workforce in non-traditional or commercial contracting practices. Dual use technology was previously funded by the Defense Advanced Research Projects Agency (DARPA), first under the Technology Reinvestment Program (TRP) and then under DUAP. In FY 1997, the decision was made to begin transferring responsibility for DUAP from DARPA to the Services. The two existing DUAP efforts, DUAP S&amp;T and Commercial Operations and Support Savings Initiative (COSSI), were split and transferred into Service 6.2 and 6.4 PEs, respectively. This PE is the Dual Use S&amp;T effort for the Air Force.</p> <p>(U) FY 1997: Not Applicable.</p> <p>(U) FY 1998: Not Applicable.</p> <p>(U) FY 1999 (\$ in Thousands):</p> <table border="0"> <tr> <td>- (U) \$10,000</td> <td>Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles.</td> </tr> <tr> <td>- (U) \$5,000</td> <td>Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.</td> </tr> <tr> <td>- (U) \$4,606</td> <td>Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.</td> </tr> <tr> <td>- (U) \$19,606</td> <td>Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.</td> </tr> <tr> <td></td> <td>Total</td> </tr> </table>												- (U) \$10,000	Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles.	- (U) \$5,000	Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.	- (U) \$4,606	Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.	- (U) \$19,606	Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.		Total
- (U) \$10,000	Develop air vehicle technologies that extend the life and improve the performance of both Air Force and commercial fixed wing air vehicles.																				
- (U) \$5,000	Areas of research include improving flight control, lightweight structures, common electronics, and vehicle subsystems.																				
- (U) \$4,606	Develop information technologies that improve the capability of both aerospace command and control, and commercial communications and awareness. Areas of research include intelligent information systems, communication systems, information fusion, and collaborative environment development.																				
- (U) \$19,606	Develop space technologies that will reduce the cost and improve the capability of both Air Force and commercial space vehicles and launch systems. Areas of research include improved space vehicle survivability, space vehicle control, and space-based sensing.																				
	Total																				

Project 4770

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Exhibit R-2 (PE 0602805F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>2 - Applied Research</b>	<b>0602805F Dual Use Applications Program (DUAP)</b>	<b>4770</b>	
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	0	0	0
(U) Adjustments to Appropriated Value	0	0	0
a. Congressional/General Reductions			
b. SBIR			
c. Omnibus/Other Above Threshold Reprogrammings			
d. Below Threshold Reprogrammings			
e. Rescissions			
(U) Adjustments to Budget Year Since FY 1998 PB			19,606
(U) Current Budget Submit/FY 1999 PB	0	0	19,606
			Cont
<b>(U) Change Summary Explanation:</b>			
Funding: Dual use technology was previously funded by the Defense Advanced Research Projects Agency (DARPA), first under the Technology Reinvestment Program (TRP) and then under DUAP. In FY 1997, the decision was made to begin transferring responsibility for DUAP from DARPA to the Services. The two existing DUAP efforts, DUAP S&T and Commercial Operations and Support Savings Initiative (COSSI), were split and transferred into Service 6.2 and 6.4 PEs, respectively. This PE is the Dual Use S&T effort for the Air Force.			
Technical: Not Applicable.			
Schedule: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
(U) Related Activities:			
- (U) This project will be coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
<b>(U) D. Schedule Profile: Not Applicable.</b>			

Project 4770

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Exhibit R-2 (PE 0602805F)

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PE NUMBER: 0603106F

PE TITLE: Logistics Systems Technology

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**3 - Advanced Technology Development****0603106F Logistics Systems Technology**

PROJECT

**2745**

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2745 Logistics Performance and Support Technology		17,059	14,502	8,677	7,883	10,381	10,523	10,810	Continuing	Continuing
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1999, three projects (Project 2745, Logistics for Contingency Operations and Weapons Systems Support; Project 2940, Technology for Design and Maintenance; and Project 2950, Improved Logistics and Maintenance Performance) are combined into a single project (Project 2745, Logistics Performance and Support Technology). The total project costs for Project 2745 reflect this consolidation.

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates cost-effective technologies to improve the design, performance, and support of current and future weapon systems. This program directly supports two of the six Air Force Core Competencies: Rapid Global Mobility and Agile Combat Support. It will also incorporate human operator, maintenance, and support considerations into the weapon systems design process and will make engineering, product support, and maintenance data electronically available throughout weapon systems' life cycles. It will provide more realistic logistics planning and combat capability assessment tools, provide technologies to reduce deployment airlift and footprint requirements, improve logistics information and command and control and asset visibility, provide critical logistics risk reduction technology, and help control total weapon systems costs.

Project 2745

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Exhibit R-2 (PE 0603106F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603106F Logistics Systems Technology	2745	
U) FY 1997 (\$ in Thousands):			
- (U) \$ 1,463	Developed and demonstrated fire suppression/extinguishing technologies.		
	- (U) Completed testing on the gas generator technology for aircraft fire suppression systems and made available for transition.		
	- (U) Further developed and flight tested the inflatable bag extinguisher technology for aircraft fire suppression.		
- (U) \$ 1,498	Developed and demonstrated repair techniques for battle damaged/accident damaged aircraft.		
	- (U) Field demonstrated and verified concepts for repairing and measuring battle damaged low-observable structures.		
	- (U) Evaluated technologies for repairing battle damaged composite structures.		
- (U) \$ 2,612	Developed processes, models, technologies, and equipment to enhance contingency operations while decreasing the logistics footprint.		
	- (U) Designed and evaluated technologies for multi-function modular aerospace ground equipment that reduce support costs and deployment footprint.		
	- (U) Designed and evaluated technologies for improved supportability and operational efficiency of support equipment and materiel handling equipment.		
- (U) \$ 1,767	Developed engineering design, analysis methods, and technologies to improve Air Force maintenance and address requirements for improved reliability/maintainability.		
	- (U) Created and validated methods for documenting maintenance technician performance requirements for automatic insertion in the Logistics Support Analysis Record.		
	- (U) Developed criteria/metrics for design engineering assessment of system deployment footprint, supportability, airlift/transportation requirements, and on-site support.		
- (U) \$ 2,567	Developed and demonstrated analysis methods to identify and meet Air Force logistics needs: improve aircraft repair/support methods.		
	- (U) Built and demonstrated data collection and decision support technologies for operational logistics requirements.		
	- (U) Tested the flexibility and accuracy of this multi-user technology with commercial analytical methods.		
	- (U) Defined requirements for analytic tool suite to improve the efficiency and affordability of the wing/depot repair process.		
- (U) \$ 1,375	Completed development/demonstrated engineering design trade off methods and software tools to make acquisition support of Air Force systems more affordable.		
- (U) \$ 4,333	Developed and demonstrated methodologies and technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field and depot maintenance.		
	- (U) Developed aircraft battle damage assessment aid demonstration system.		
	- (U) Designed a system to demonstrate integrated technical information for the Air Logistics Centers.		
- (U) \$ 1,444	Developed and demonstrated technologies for improved logistics planning and deployed maintenance operations.		
	- (U) Completed information analysis required to develop technologies to improve wing level logistics planning environment.		
- (U) \$17,059	Total		

Project 2745

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Exhibit R-2 (PE 0603106F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603106F Logistics Systems Technology	2745	
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 1,219	Continue to develop repair technologies for battle and accident damaged aircraft.		
	- (U) Field test, document, and transition composite and low-observable structure repair technologies.		
	- (U) Compare and assess available commercial technologies to achieve minimized sound, thermal, and pollution signature and operational residuals.		
- (U) \$ 3,592	Continue to develop technologies to enhance rapid logistics contingency planning/operations directed towards rapid response, reduce footprint, and improve asset distribution management (place, time, materials, quantities) for logistics support.		
	- (U) Develop advanced deployment/process planning analysis and execution tools; identify essential elements required to support rapid response forces with required initial and sustaining support elements.		
	- (U) Fully define operational requirements for next generation highly reliable, reconfigurable, and easily deployable multi-function, modular support equipment.		
	- (U) Continue technology development to reduce airlift requirements and on-site footprint using multifunction support equipment.		
- (U) \$ 2,492	Continue development of engineering design, analysis methods, and technologies to improve Air Force maintenance and support to improve reliability, maintenance, and deployability.		
	- (U) Complete and transition advanced computer-based maintainability assessment and support data generation using high fidelity human performance models and maintenance task simulations.		
	- (U) Complete and transition analytic tool suites to improve the efficiency and affordability of the wing/depot repair process.		
- (U) \$ 2,211	Complete, demonstrate, and transition analysis tools to ensure tight correlation between specific operational user requirements and system acquisition, repair, and modification.		
	- (U) Develop and assess technologies to balance operational user requirements with affordability, reliability, and supportability requirements.		
	- (U) Complete and demonstrate impact of collaborative technologies for distributed, multi-media, multi-user assessments, trade off, and coordination for consolidation and prioritization of operational logistics requirements.		
- (U) \$ 4,988	Continue to develop and demonstrate technologies to evaluate the benefits of electronic technical data for planning and implementing various types of field, depot, and deployed maintenance.		
	- (U) Continue aircraft battle damage assessment aid demonstration system development.		
	- (U) Complete, demonstrate, and transition program for integrated technical information for the Air Logistics Centers.		
- (U) \$14,502	Total		

Project 2745

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Exhibit R-2 (PE 0603106F)

Project 2745

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Exhibit R-2 (PE 0603106F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>		<b>0603106F Logistics Systems Technology</b>	<b>2745</b>
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,230		Continue development of technologies to enhance rapid contingency planning/operations directed towards rapid response, reduce footprint, and improve "just-in-time" logistics support.	
		- (U) Field demonstrate advanced deployment planning and execution process planning and analysis tools; identify essential elements required to support rapid response forces with required initial and sustaining support elements.	
- (U) \$2,572		- (U) Evaluate, develop and integrate tools and process improvements identified as shortfalls as a result of the field demonstration. Continue to develop technologies for next generation, multi-function, modular support equipment that is highly reliable, reconfigurable, and easily deployable.	
- (U) \$2,253		- (U) Demonstrate technologies that reduce airlift requirements and on-site footprint for multifunction support equipment. Continue to develop and demonstrate technologies to improve deployed maintenance operations and evaluate the benefits of electronic technical data to support deployed maintenance.	
- (U) \$ 622		- (U) Field test and demonstrate aircraft battle damage assessment aiding technology. Continue to develop and demonstrate technologies for improved wing level command and control of logistics assets.	
		- (U) Complete initial design requirements for fully integrated wing level logistics information system.	
- (U) \$8,677		- (U) Preliminary demonstrations of integrated information/display technologies to improve command/control of asset distribution.	
		Total	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603106F Logistics Systems Technology

2745

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

    a. Congressional/General Reductions

    b. SBIR

    c. Omnibus/Other Above Threshold Reprogrammings

    d. Below Threshold Reprogrammings

    e. Rescissions

(U) Adjustments to Budget Year Since FY 1998 PB

(U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	17,467	15,338	17,775	Cost
	18,254	15,338		Cont
	-383	-502		
	-404	-334		
	-379			
	-29			
	17,059	14,502	-9,098	
			8,677	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

Project 2745

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Exhibit R-2 (PE 0603106F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603106F Logistics Systems Technology	2745	
<p>(U) C. <u>Other Program Funding Summary</u>: Not Applicable.</p> <p>(U) <u>Related Activities</u>:</p> <ul style="list-style-type: none"><li>- (U) PE 0207219F, Advanced Tactical Fighter.</li><li>- (U) PE 0602201F, Aerospace Flight Dynamics.</li><li>- (U) PE 0602202F, Armstrong Lab Exploratory Development.</li><li>- (U) PE 0603721N, Integrated Diagnostic System.</li><li>- (U) PE 0604708F, Generic Integrated Maintenance Diagnostics Systems.</li><li>- (U) PE 0604740F, Computer Resource Management Technology.</li><li>- (U) PE 0605801A, Pollution Prevention Research and Development.</li><li>- (U) PE 0708011F, Manufacturing Technology.</li><li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li></ul> <p>(U) D. <u>Schedule Profile</u>: Not Applicable.</p>			

Project 2745

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Exhibit R-3 (PE 0603106F)

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PE NUMBER: 0603108F

PE TITLE: Integrated Data Systems (IDS)

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# RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603108F Integrated Data Systems (IDS)

PROJECT

4427

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4427 Integrated Maintenance Data Systems (IMDS)		0*	18,541	0*	0*	0*	0*	0*	Continuing	Continuing
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

\* FY 97 and FY 99 and outyear funding resides within PE 0708611F, Project 4654. Following FY 98, all funds for IMDS reside within PE 0708611F. All backup and justification material associated with this program is located within that PE.

## (U) A. Mission Description and Budget Item Justification

The IMDS program is an evolutionary acquisition program to develop and field an AF standard maintenance information system. This program element integrates information systems supporting Air Force maintenance activities into a single open architecture, modern decision support system. This enhanced decision support system will increase operational production capability and support system efficiency, while decreasing mobility infrastructure requirements and cost of operations. The IMDS System will be integrated with the Combat Support Information System (CSIS) being developed by the Global Combat Support System - Air Force (GCSS-AF) Program. IMDS integrates multiple and diverse maintenance Management Information Systems into a single open system client/server network. IMDS will provide a single virtual data repository for access by all Air Force command levels. Full IMDS capability is reached through six increments of the application software, each increment building on the previous one. The first increment entered test at Eglin AFB July 97 after one year of development. The second increment will enter test in Summer 98 with delivery starting to the field in 2nd Quarter FY98. Increments 1&2 establish core capabilities at the retail level. Increment 3 starts wholesale level functionality as well as continued expansion of retail capabilities. This program is Budget Activity 7, Operational System Development, because projects are being engineered to support already operational weapon systems.

## (U) Acquisition Strategy:

All major contracts within this Program Element were awarded after full and open competition.

## (U) FY 1997 (\$ in Thousands):

- (U) \$0 Funding resides within PE 0708611F. See description for PE 0708611F, Project 4654

Project 4427

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Exhibit R-2 (PE 0603108F)

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development 0603108F Integrated Data Systems (IDS) 4427

## (U) FY 1998 (\$ in Thousands):

- (U) IMDS system contract  
 - (U) \$13,511 Increment 2  
 - (U) \$788 Increment 3  
 - (U) Operations  
 - (U) 2,459 Support Contractors  
 - (U) 1,783 SPO Operations  
 - (U) \$18,541 Total

## (U) FY 1999 (\$ in Thousands) (funding resides within PE 0708611F, project 4654):

- (U) \$0 Funding resides within PE 0708611F. See description for PE 0708611F, Project 4654

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997*	FY 1998	FY 1999*	Total Cost Continuing
(U) Previous President's Budget FY 1998 PB	17,332	19,753	19,706	
(U) Appropriated Value	18,232	19,753		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-456	-760		
b. SBIR	-444	-452		
c. Omnibus or Other Above Threshold Reprogramming	-17,332			
d. Below Threshold Reprogramming				
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-19,706	
(U) Current Budget Submit/FY 1999 President's Budget	0	18,541	0	Continuing

\*

Project 4427

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Exhibit R-2 (PE 0603108F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603108F Integrated Data Systems (IDS)

4427

(U) Change Summary Explanation:

Funding: \* FY 97 and FY 99 and outyear funding now resides within PE 0708611F, Project 4654. The FY 98 budget was not transferred to PE 0708611F. Instead, FY 98 funds will be executed in PE 0603108F to avoid programmatic impacts and potential accounting problems that may result from reclassification. Following FY 98, all funds for IMDS reside within PE 0708611F.

Schedule: OT&E delayed one year due to funding cuts and Quadrennial Defense Review (QDR) impacts to beta sites and requirements changes.

Technical: Not applicable.

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl Cont	Total Cost Cont
(U) Other Procurement AF, BA 7, P-1:55, IMDS (PE 0708611F)		2,800	2,751	2,721	2,686	2,688	2,648		
(U) O&M (IMDS) (PE 0708611F)		886	949	1,879	1,855	1,891	1,926		

Related RDT&E:

(U) PE 0708611F, Project 4654, Integrated  
Maintenance Data System (IMDS)\*

(U) D. Schedule Profile

See description for PE 0708611F, Project 4654.

Project 4427

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Exhibit R-2 (PE 0603108F)

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PE NUMBER: 0603112F

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PE TITLE: Advanced Materials for Weapon Systems

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE	February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE								
3 - Advanced Technology Development		0603112F Advanced Materials for Weapon Systems								
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost		23,524	26,503	21,006	22,629	22,792	22,862	23,463	Continuing	Continuing
2100	Laser Hardened Materials	9,033	9,546	10,994	11,803	11,882	11,915	12,211	Continuing	Continuing
3153	Non-Destructive Inspection Development	7,515	6,575	4,507	4,839	4,872	4,886	5,009	Continuing	Continuing
3946	Materials Transition	6,976	10,382	5,505	5,987	6,038	6,061	6,243	Continuing	Continuing
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program demonstrates materials technology options for application into Air Force weapon systems. Developing materials technologies for the broadband laser protection of aircrews and sensors from a variety of threats is a high priority of the Air Force. The Non-Destructive Inspection/Evaluation (NDI/E) techniques for fighter, bomber, and transport aircraft are critical to the logistics centers as well as the operational fleet as the service lives of these systems increase. This program provides critical data for prospective users to make engineering decisions on both structural and non-structural materials for air and space. Reducing risk in materials technology improves the affordability, supportability, reliability, survivability, and operational performance of current and future warfighting systems. Note: For FY 1998, Congress added \$2.5 million for metal fatigue sensing technology and \$5.0 million for infrared signature suppression materials which explains the perceived decrease in FY 1999. In FYs 1998 and out, additional emphasis has been placed on improved materials and sustainment of aging aircraft.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		February 1998
3 - Advanced Technology Development		
PE NUMBER AND TITLE		
0603112F Advanced Materials for Weapon Systems		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	25,136	20,596
(U) Adjustments to Appropriated Value	26,303	28,096
a. Congressional/General Reductions	-557	-952
b. SBIR	-610	-641
c. Omnibus/Other Above Threshold Reprogrammings	-70	
d. Below Threshold Reprogrammings	-1,500	
e. Rescissions	-42	
(U) Adjustments to Budget Year Since FY 1998 PB	23,524	26,503
(U) Current Budget Submit/FY 1999 PB		-423
		21,006
		Total
		Cost
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.		
(U) D. <u>Schedule Profile:</u> Not Applicable.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603112F Advanced Materials for Weapon

Systems

PROJECT

2100

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2100 Laser Hardened Materials	9,033	9,546	10,994	11,803	11,882	11,915	12,211	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops new materials and concepts for protecting Air Force assets such as aircrews, munitions, sensors, and structures against laser radiation. The goal is to ensure mission capability before, during, and after laser exposure. The world laser market is rapidly expanding with easy export to any nation. Survivability solutions must account for a variety of lasers facing a mission. Current protection schemes are activated by intensity or color and are only capable of countering a specific portion of the laser threat. To harden systems against all potential lasers, a combination of approaches is required. Concepts are demonstrated to provide hardening options for transition to Air Force systems.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,363 Developed advanced materials technologies that enhance laser hardening for Air Force aircraft structures.
- (U) Completed evaluation of structural materials laser susceptibility under various mission profiles.
- (U) Fabricated sub-scale canopy for demonstration of canopy laser protection technologies.
- (U) Developed advanced materials technologies that enhance laser hardening for Air Force aircrews.
- (U) Evaluated demonstrated laser hardening approaches for application in helmet-mounted displays.
- (U) Investigated the use of advanced protection coatings in night vision goggles.
- (U) Developed advanced materials technologies that enhance laser hardening for sensors, avionics, and components.
- (U) Completed hardened forward looking infrared (FLIR) system demonstration.
- (U) Developed technologies to protect low light level television systems.
- (U) \$9,033 Total

Project 2100

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603112F Advanced Materials for Weapon Systems	2100	
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,400	Develop advanced materials technologies that enhance laser hardening for Air Force aircraft structures.		
- (U) \$4,098	<ul style="list-style-type: none"><li>(U) Develop high-power mid-wave infrared laser evaluation technologies for simulating continuous and pulsed wave threats.</li><li>(U) Develop improved durability topcoats for externally applied laser protection coatings on canopies and aircrew visors.</li></ul>		
- (U) \$4,048	<ul style="list-style-type: none"><li>(U) Demonstrate wrap-around holographic spectacles for multi-band laser protection.</li><li>(U) Demonstrate fixed wavelength filter protection technology for night vision goggles.</li></ul>		
- (U) \$9,546	<ul style="list-style-type: none"><li>(U) Develop advanced materials technologies that enhance laser hardening for sensors, avionics, and components.</li><li>(U) Demonstrate intrinsically hard infrared detector materials technology for advanced electro-optical sensors.</li><li>(U) Demonstrate hardened retrofit modules for forward looking infrared (FLIR) sensors.</li></ul>		
Total			
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,617	Develop advanced materials technologies that enhance laser hardening for Air Force aircraft structures.		
- (U) \$4,717	<ul style="list-style-type: none"><li>(U) Investigate susceptibility of structural components of Unmanned Aerial Vehicles (UAVs) and high value munitions to medium power lasers.</li><li>(U) Continue development of environmentally durable topcoats for canopy and aircrew visor protective coating techniques.</li></ul>		
- (U) \$4,660	<ul style="list-style-type: none"><li>(U) Develop advanced materials technologies that enhance laser hardening for Air Force aircrews.</li><li>(U) Demonstrate tristimulus spectacles for interim agile (broad band) laser eye protection.</li><li>(U) Demonstrate narrow notch, angle insensitive rugate coatings for night vision goggle laser protection.</li></ul>		
- (U) \$10,994	<ul style="list-style-type: none"><li>(U) Develop advanced materials technologies that enhance laser hardening for sensors, avionics, and components.</li><li>(U) Investigate broad-spectrum limiters for protection of multicolor infrared focal plan array (FPA) detectors.</li><li>(U) Demonstrate optical limiter technologies for high value seekers and munitions.</li></ul>		
Total			

Project 2100

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Exhibit R-2 (PE 0603112F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603112F Advanced Materials for Weapon Systems

PROJECT

2100

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	9,419	10,133	11,215	Cost
	9,033	9,546	10,994	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0604706F, Life Support System.
- (U) Coordinated through the Tri-Service Laser Hardening Materials and Structures Working Group and the Joint Service Agile Laser Eye Protection Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603112F Advanced Materials for Weapon

PROJECT

3153

## Systems

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3153 Non-Destructive Inspection Development	7,515	6,575	4,507	4,839	4,872	4,886	5,009	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates advanced Non-Destructive Inspection/Evaluation (NDI/E) methods and procedures to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many designs, manufacturing, and maintenance practices. Reduction in the number of fighter wings and the need for rapid sortie generation demand an ability to perform real-time NDI/E's faster than current capability. This project provides technology to satisfy critical Air Force requirements to extend lifetimes of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels, as well as assuring manufacturing quality, integrity, and safety requirements.

## (U) FY 1997 (\$ in Thousands):

- (U) \$5,906 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft.
- (U) Continued to develop corrosion detection systems for passive detection of aircraft structural corrosion.
- (U) Developed technologies for the inspection of turbine engine components.
- (U) Developed software to facilitate combined expert data analysis of various NDI/E inspection techniques (data fusion) to improve inspection throughput and reliability.
- (U) Assessed x-ray radiography inspection/evaluation techniques for complex structures on aging aircraft.
- (U) \$644 Develop advanced inspection technologies supporting fielded and emerging aerospace systems.
- (U) Assessed inspection/evaluation techniques for stealth aircraft structures.
- (U) Assessed Air Force needs for NDI/E techniques as applied to space and space launch systems.
- (U) \$965 Develop advanced technologies for improved NDI/E capabilities in materials testing, monitoring, inspection and maintenance.
- (U) Developed remote inspection microwave non-destructive evaluation techniques for aircraft structures.
- (U) Assessed technologies for laser-based ultrasonic detection of hidden flaws in complex aircraft structures.
- (U) Evaluated the use of computed tomography for failure analysis of complex structures.
- (U) \$7,515 Total

Project 3153

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603112F Advanced Materials for Weapon

3153

Systems

## (U) FY 1998 (\$ in Thousands):

- (U) \$5,560 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft.
  - (U) Investigate emerging approaches to the detection of hidden corrosion.
  - (U) Continue development technologies for the inspection of turbine engine components.
  - (U) Demonstrate data fusion software for expert data analysis on select weapon system(s) applications.
  - (U) Develop x-ray radiography inspection/evaluation techniques for complex structures on aging aircraft.
- (U) \$175 Develop advanced inspection technologies supporting fielded and emerging aerospace systems.
- (U) \$840 Initiate advanced development of NDE/I technology opportunities for application to space and space launch systems.
- (U) \$840 Develop advanced technologies for improved NDI/E capabilities in materials testing, monitoring, inspection, and maintenance.
- (U) \$6,575 Develop technologies for laser-based ultrasonic detection of hidden flaws in complex aircraft structures.
- (U) \$6,575 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$3,039 Develop advanced technologies for improved capabilities in materials corrosion and fatigue monitoring and testing of aging aircraft.
  - (U) Develop emerging approaches to the detection of hidden corrosion.
  - (U) Demonstrate advanced NDI/E techniques for the inspection of turbine engine components.
  - (U) Optimize x-ray radiography inspection/evaluation techniques for complex structures on aging aircraft.
- (U) \$612 Develop advanced inspection technologies supporting fielded and emerging aerospace systems.
- (U) \$856 Complete development of NDE/I technology opportunities for application to space and space launch systems.
- (U) \$856 Develop multiple advanced NDI/E technologies for the inspection of stealth aircraft systems and components.
- (U) \$856 Integrate NDE results into ballistic performance models for rapid assessment of rocket motor propellant service life.
- (U) \$856 Develop advanced technologies for improved NDI/E capabilities in materials testing, monitoring, inspection and maintenance.
- (U) \$4,507 Demonstrate technologies for laser-based ultrasonic detection of hidden flaws in complex aircraft structures.
- (U) \$4,507 Total

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BUDGET ACTIVITY

PE NUMBER AND TITLE

0603112F Advanced Materials for Weapon  
Systems PROJECT  
3153

## 3 - Advanced Technology Development

(U) B. Program Change Summary (\$ in Thousands):(U) Previous President's Budget (FY 1998 PB)  
(U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	7,778	4,472	4,598	Cost
	7,515	6,575	4,507	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603112F Advanced Materials for Weapon

PROJECT

3946

## Systems

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3946 Materials Transition	6,976	10,382	5,505	5,987	6,038	6,061	6,243	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops data to accelerate the time to scale-up new defense-related materials and achieve their acceptance by designers. The goal is to reduce risk, improve confidence, and reduce cost of the incorporation of new materials into weapons, airframes, engine, and space applications. Advanced materials and related processes that have matured beyond exploratory development are characterized and critical data is developed to reduce the risk of demonstrating these technologies in Air Force applications. Critical evaluations of materials in the proposed design environment are performed. This design and scale-up data provides confidence to transition new materials to upgrades and future Air Force systems as well as provide the initial incentive for their industrial development.

## (U) FY 1997 (\$ in Thousands):

- (U) \$2,016 Developed defense-related materials technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
  - (U) Scaled-up and evaluated improved infrared signature reduction coatings for aircraft.
  - (U) Continued development of new wrought gamma titanium processes for application in advanced turbine engines.
- (U) \$2,725 Developed technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
  - (U) Completed demonstration of durable infrared window materials and coatings for high temperature and debris environments.
  - (U) Developed thermal control coatings for space applications.
- (U) \$565 Developed technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
  - (U) Continued to characterize the physical properties of advanced structural materials and provide design allowable data to designers.
  - (U) Continued to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) \$1,670 Developed and demonstrated engineering design trade off methods to allow designers and users to assess affordability versus performance, support cost, risk, etc. in early development.
- (U) \$6,976 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

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3 - Advanced Technology Development

0603112F Advanced Materials for Weapon

3946

Systems

## (U) FY 1998 (\$ in Thousands):

- (U) \$7,017 Develop technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
- (U) \$2,945 Demonstrate lightweight structural composite materials for spacecraft radiators and thermal control components.
- (U) \$2,945 Demonstrate processing techniques for net shape, low-cost titanium turbine engine components.
- (U) \$420 Develop technologies and data bases to facilitate timely transition of advanced electronics, optics, and survivability materials to warfighters, industry, and academia.
- (U) \$10,382 Scale-up processing techniques for advanced two-color, infrared suppression coatings and treatment for advanced aircraft.
- (U) \$10,382 Demonstrate a tough, durable, affordable window for infrared imaging sensors for advanced aircraft.
- (U) \$10,382 Develop technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
- (U) \$10,382 Continue to characterize the physical properties of advanced structural materials and provide design data to designers.
- (U) \$10,382 Continue to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) \$10,382 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$2,232 Develop technologies and data bases to facilitate timely transition of advanced structures, propulsion, and subsystems materials to warfighters, industry, and academia.
- (U) \$2,858 Demonstrate thermal control coatings on advanced, high thermal conductivity composites for spacecraft thermal control.
- (U) \$2,858 Demonstrate low-cost, wrought titanium aluminide alloys and processing techniques for advanced turbine engines.
- (U) \$2,858 Develop technologies and data bases to facilitate timely transition of advanced materials for high power radars, space-based sensors, and infrared countermeasures to warfighters, industry, and academia.
- (U) \$2,858 Demonstrate zinc germanium phosphide (ZnGeP) as a tunable laser source for advanced infrared countermeasures.
- (U) \$2,858 Demonstrate advanced processing techniques for the growth of mercury cadmium telluride infrared detector materials for advanced space-based sensor systems.
- (U) \$415 Develop technologies and data bases to facilitate timely transition of advanced materials for improved systems support and operational support to warfighters, industry, and academia.
- (U) \$5,505 Continue to characterize the physical properties of advanced structural materials and provide design data to designers.
- (U) \$5,505 Continue to evaluate improved materials and materials processes for potential use in aircraft systems.
- (U) \$5,505 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603112F Advanced Materials for Weapon

3946

Systems

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	7,939	5,991	5,616	Cost
	6,976	10,382	5,505	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603202F, Aerospace Propulsion Subsystem Integration.
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.
- (U) PE 0603216F, Aerospace Propulsion and Power Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603202F

PE TITLE: Aerospace Propulsion Subsystem Integration

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**3 - Advanced Technology Development****0603202F Aerospace Propulsion Subsystem**

PROJECT

**668A****Integration**

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
668A	Aircraft Propulsion Subsystem Integration	23,919	23,378	30,814	31,616	32,620	31,494	33,214	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates gas turbine propulsion system technologies applicable to a broad range of aircraft. The Aircraft Propulsion Subsystem Integration (APSI) program includes demonstrator engines such as the Joint Technology Demonstrator Engine (JTDE) for manned systems and the Joint Expendable Turbine Engine Concept (JETEC) for uninhabited air vehicle and cruise missile applications. These demonstrator engines apply the core technology developed under the Advanced Turbine Engine Gas Generator (ATEGG) program coupled with affordable and durable system component technology such as low pressure fans and low pressure turbines (LPT), engine controls, and nozzles developed as part of APSI. This program also focuses on system integration aspects of inlets, nozzles, engine/airframe compatibility, and low-observable technologies. APSI will provide aircraft with potential for longer range and higher cruise speed with lower specific fuel consumption; surge power for successful engagements; high sortie rates with reduced maintenance; reduced life cycle cost; and improved survivability resulting in increased mission effectiveness. The APSI program supports the demonstration of performance, cost, and durability goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DOD, DARPA, NASA, and industry initiative focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness.

Project 668A

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

668A

Integration

## (U) FY 1997 (\$ in Thousands):

- (U) \$3,940 Designed, fabricated, and demonstrated fans, low pressure turbines, engine controls, exhaust nozzles, and integration technology for turbofan/turbojet engines for current and future Air Force aircraft.
- (U) Completed fabrication and demonstrated distributed and model-based engine controls.
- (U) Demonstrated ceramic composite components for exhaust nozzles.
- (U) \$16,142 Designed, fabricated, and tested technology demonstration engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports.
- (U) Completed fabrication and demonstrated forward swept fan technology.
- (U) Completed fabrication and demonstrated Castool and Internal Convective Enhancement (ICE) turbines.
- (U) Completed fabrication and demonstrated integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine.
- (U) Completed fabrication and demonstrated variable cycle engine with fixed geometry, fluidic area control, and fluidic thrust vectoring exhaust technologies.
- (U) \$3,837 Designed, fabricated, and tested technology demonstration engines for expendable engines for missile applications.
- (U) Demonstrated high pressure ratio, forward swept compressor stage.
- (U) Demonstrated efficient, lightweight lamilloy hot section with first use of high temperature capable MA754 sheet material.
- (U) Demonstrated low-cost, uncooled ceramic hot section.
- (U) \$23,919 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$4,937 Design, fabricate, and demonstrate durability and integration technologies for turbofan/turbojet engines for current and future Air Force aircraft.
- (U) Complete fabrication of model-based, distributed and active stability engine controls.
- (U) Complete fabrication of integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine
- (U) Apply laser shot peening to increase durability of turbine engine components.
- (U) \$14,359 Design and fabricate technology demonstration turbofan/turbojet engines for fighters, attack aircraft, bombers, and transports.
- (U) Complete fabrication of advanced lightweight, high strength materials for turbine engine components.
- (U) Complete fabrication of variable cycle engine with a swirl augmentor and fixed geometry thermal and fluidic area control exhaust nozzle.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603202F Aerospace Propulsion Subsystem

668A

## Integration

- (U) \$4,082	Design, fabricate, and test technology demonstration engines for missile and uninhabited air vehicle applications.
- (U)	Design high temperature shrouded compressor.
- (U)	Design low-cost ceramic matrix composite (CMC) combustor.
- (U)	Design low-cost, high efficiency, uncooled carbon-carbon turbine.
- (U)	Design rich burn nozzle and controls for thrust augmentation.
- (U)	Design advanced engine components to increase affordability and high temperature operation with reduced cooling requirements.
Total	
- (U) \$23,378	
(U) FY 1999 (\$ in Thousands):	
- (U) \$4,148	Design, fabricate, and demonstrate controls technology for turbofan/turbojet engines for current and future Air Force aircraft.
- (U)	Demonstrate model-based, distributed and active stability engine controls.
- (U)	Conduct preliminary design for fully distributed and active stability engine controls.
- (U)	Design integral starter/generator.
- (U) \$10,136	Design, fabricate, and demonstrate durability and integration technology for turbofan/turbojet engines for current and future Air Force aircraft.
- (U)	Demonstrate laser shot peening to increase durability of turbine engine components.
- (U)	Demonstrate integration technologies including metal matrix composite shafts, hybrid ceramic bearings, and counterrotating vaneless turbine
- (U)	Conduct preliminary design of more affordable integration technologies including composite hot section components, advanced fan, and low-observable exhaust nozzles.
- (U) \$11,306	Design, fabricate, and test technology demonstration engines for turbofan/turbojet engines for fighters, aircraft, bombers, and transports.
- (U)	Demonstrate variable cycle engine with a swirl augmentor and fixed geometry thermal and fluidic area control exhaust nozzle.
- (U)	Design, fabricate, and demonstrate advanced hot section cooling system.
- (U) \$5,224	Design, fabricate, and test technology demonstration engines for missile and uninhabited air vehicle applications.
- (U)	Fabricate high temperature shrouded compressor.
- (U)	Fabricate low-cost CMC combustor.
- (U)	Fabricate low-cost, high efficiency, uncooled carbon-carbon turbine.
- (U)	Fabricate rich burn nozzle and controls for thrust augmentation.
- (U)	Fabricate advanced engine components that are more affordable and capable of high temperature operation with reduced cooling requirements.
Total	
- (U) \$30,814	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
3 - Advanced Technology Development		668A	
PE NUMBER AND TITLE		0603202F Aerospace Propulsion Subsystem	
Integration			
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	27,031	30,564	31,434
(U) Adjustments to Appropriated Value	28,318	24,785	
a. Congressional/General Reductions	-594	-810	
b. SBIR	-693	-597	
c. Omnibus/Other Above Threshold Reprogrammings	-72		
d. Below Threshold Reprogrammings	-3,000		
e. Rescissions	-40		
(U) Adjustments to Budget Years Since FY 1998 PB	23,919	23,378	-620
(U) Current Budget Submit/FY 1999 PB			30,814
			Cont
<b>(U) Change Summary Explanation:</b>			
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
-	(U) PE 0602203F, Aerospace Propulsion.		
-	(U) PE 0603112F, Advanced Materials for Weapon Systems.		
-	(U) PE 0603216F, Aerospace Propulsion and Power Technology.		
-	(U) PE 0602122N, Aircraft Technology.		
-	(U) PE 0603217N, Air Systems Advanced Technology Demonstration.		
-	(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.		
<b>(U) D. Schedule Profile: Not Applicable.</b>			

PE NUMBER: 0603203F

UNCLASSIFIED

PE TITLE: Advanced Avionics for Aerospace Vehicles

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE		February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE								
3 - Advanced Technology Development		0603203F Advanced Avionics for Aerospace Vehicles								
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	28,240	25,077	26,442	25,148	26,269	26,499	27,309	Continuing	Continuing
665A	Airborne Sensors Technology	12,307	11,707	11,332	10,502	10,853	11,076	11,344	Continuing	Continuing
69CK	Advanced Electronics	3,273	1,450	1,568	1,071	1,234	1,246	1,442	Continuing	Continuing
69DF	Target Attack and Recognition Technology	12,660	11,920	13,542	13,575	14,182	14,177	14,523	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops technology to enable continued avionics superiority. Combat aircraft must defeat increasingly sophisticated active and passive countermeasures, destroy a wide variety of targets with precision, and reliably perform complex missions with less logistics support in a world of proliferating threats. This program responds to these needs by developing and demonstrating aerospace platform technologies and techniques for advanced radio frequency sensors (i.e., radar) and electro-optical sensors for air and ground targeting including: electronic countermeasures; advanced electronics technologies for improvements in cost, weight, and reliability; fire control/weapon delivery; target identification and recognition technologies; and techniques for precision air and ground target identification. Emphasis is on detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets while providing the capability to adapt to changes in target signatures and background environments. These advanced avionics capabilities will provide for flexible, multi-function/multi-mission combat aircraft that can: safely penetrate threat areas; destroy multiple ground targets per pass; accurately detect and identify targets beyond-visual-range within a complex mix of look-alike friendly, neutral, and enemy aircraft; win aerial engagements; and return to fight again.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE			
3 - Advanced Technology Development		0603203F Advanced Avionics for Aerospace Vehicles			
(U) B. <u>Program Change Summary (\$ in Thousands):</u>					
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total	
(U) Appropriated Value	27,475	26,507	28,206	Cost	
(U) Adjustments to Appropriated Value	28,691	26,507		Cont	
a. Congressional/General Reductions	-611	-879			
b. SBIR	-605	-551			
c. Omnibus/Other Above Threshold Reprogrammings	-190				
d. Below Threshold Reprogrammings	1,000				
e. Rescissions	-45				
(U) Adjustments to Budget Year Since FY1998 PB	28,240	25,077	-1,764		
(U) Current Budget Submit/FY 1999 PB			26,442	Cont	
(U) Change Summary Explanation:					
Funding: Changes to this PE since the previous President's Budget are due higher priorities within the Science and Technology (S&T) Program.					
Below Threshold Reprogramming is for a Digital Enhancement Program for tactical airborne radars.					
Schedule: Not Applicable.					
Technical: Not Applicable.					
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.					
(U) D. <u>Schedule Profile:</u> Not Applicable.					

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Exhibit R-2 (PE 0603203E)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603203F Advanced Avionics for Aerospace

PROJECT

665A

Vehicles

COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
665A Airborne Sensors Technology	12,307	11,707	11,332	10,502	10,853	11,076	11,344	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates aerospace platform sensor technologies, including electro-optical sensors, radars, and electronic counter-countermeasures (ECCM) for radars. This project provides the warfighter with the capability to precisely detect and target both airborne targets (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Work includes developing both complete sensor capabilities as well as advanced component technologies. The desired warfighting capability includes the ability to detect and target in difficult background conditions, with emphasis on countering improvements in camouflage, concealment, and deception techniques that limit current detection and tracking capability for threats obscured by these means.

## (U) FY 1997 (\$ in Thousands):

- (U) \$218 Develop affordable multi-function electro-optical sensor technology for long-range target detection and track/missile warning. This effort will combine the offensive and defensive functions into a single electro-optical sensor, reducing volume and cost of the overall system.
- (U) \$873 Defined multi-function sensor technologies for an integrated offensive and defensive sensor system.
- (U) \$873 Develop airborne, air-to-ground, wind profiling technologies to enhance first shot hit capability of gunships and for greater precision air drops from cargo aircraft. This technology will decrease loiter time and increase operational altitude, thus, improving survivability.
- (U) \$873 Completed evaluation and transitioned wind profiling system in cooperation with Warner Robins Air Logistics Command.
- (U) \$873 Investigated technology issues related to improving cargo drop performance on transport aircraft.
- (U) \$873 Develop and demonstrate, through a tri-Service program, the multi-spectral electro-optical sensor and algorithm technology required to passively search large areas, detect, and target ground-based targets in the open and under cover. Passive search allows the user to remain covert.
- (U) Verified multi-spectral targeting sensor performance using tower data for joint United Kingdom/France/U.S. Air Force/U.S. Navy advanced fire control development program.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles	665A	
- (U) \$2,255	Develop, demonstrate, and evaluate advanced laser technologies that provide pilots with positive, timely, and reliable identification information that is compatible with existing reliable identification/identify friend or foe techniques. This technology will be packaged for existing electro-optical systems and provide the capability for air-to-air missile launch at 60 km and air-to-ground weapon launch at 15-25 km.		
	- (U) Demonstrated three-dimensional imaging capability in a field test.		
	- (U) Evaluated synthetic aperture radar ECCM techniques that allow all-weather targeting of high-value ground targets while under severe jamming.		
	- (U) Performed laboratory and roofhouse demonstrations of electronic protection techniques for transition to front-line fighters and bombers operating in harsh electronic countermeasure environments.		
- (U) \$2,684	Develop adaptive processing techniques to negate clutter and electromagnetic interference, both intentional and intentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets.		
	- (U) Continued to develop innovative concepts to eliminate clutter and interference from other sensors on board and enable the maximum possible target detection and tracking range.		
	- (U) Used airborne radar data to perform cost/performance trade studies of advanced clutter/interference mitigation techniques.		
- (U) \$1,932	Develop and demonstrate, through an Air Force/Navy/Defense Advanced Research Projects Agency program, the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques.		
	- (U) Performed ground demonstration of real-time, automatic detection of concealed/camouflaged, high-value, time-critical targets.		
	- (U) Developed sensor specification for an airborne, all-weather, concealed target detection sensor.		
- (U) \$1,769	Develop critical components required to lower life cycle cost of radar apertures for operational and future radar systems.		
	- (U) Fabricated low-cost antenna aperture for improved performance of electronic scanned arrays.		
	- (U) Performed experiments to evaluate aperture technology for performance and reliability under laboratory conditions and harsh operating environments.		
- (U) \$12,307	- (U) Developed radar aperture technology with life cycle cost reduction goal of 20-40%.		
	Total		

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Exhibit R-2 (PE 0603203F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles	665A	
(U) FY 1998 (\$ in Thousands):	Develop integrated air-to-air and air-to-ground electro-optical sensor technologies to detect and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This technology will enable warfighters to engage mobile strategic targets.		
- (U) \$2,430	- (U) Complete collection of field test data for the design of a day/night multispectral sensor capable of detection of deep hide targets.		
	- (U) Initiate a multi-national program to demonstrate affordable, real-time, air-to-ground and air-to-air precision targeting capability from survivable stand-off ranges (20 km).		
- (U) \$2,483	Develop airborne, air-to-ground wind profiling technologies to enhance accuracy of bomb drops and cargo delivery.		
	- (U) Demonstrate modular wind profiler that shows four to ten times improvement in air drop accuracy from 28,000 feet.		
- (U) \$1,241	- (U) Complete design and begin fabrication of wind sensor system to improve unguided bombing accuracies.		
	Develop and demonstrate radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures.		
	- (U) Develop electronic protection techniques against emerging threats, including application of neural nets to identify and remove jamming waveforms, and use real radar imagery to assess improvements.		
- (U) \$3,103	Develop processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets.		
	- (U) Refine advanced, integrated, air-to-air/air-to-ground, clutter/interference techniques to restore high performance radar capabilities in severe jamming and clutter environments. Demonstrate a four times improvement in acquisition range through adaptive processing.		
- (U) \$1,117	Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques.		
	- (U) Demonstrate, through an Air Force/Army/Defense Advanced Research Projects Agency program, real-time automatic detection algorithms in unmanned aerial vehicle-sized radar hardware in preparation for flight demonstration of all-weather, obscured target detection.		
- (U) \$1,333	Develop critical components required to lower life cycle cost of current and future radar systems.		
	- (U) Perform experiments to evaluate antenna technology for performance and reliability improvements under laboratory conditions.		
- (U) \$11,707	- (U) Conduct flight tests of an advanced air platform antenna for precision weapon delivery.		
	Total		

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Exhibit R-2 (PE 0603203F)

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Exhibit R-2 (PE 0603203F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles	665A	
(U) FY 1999 (\$ in Thousands):			
- (U) \$2,172	Develop integrated air-to-air and air-to-ground electro-optical (EO) sensor technologies to detect and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. This technology will enable warfighters to engage mobile strategic targets.		
- (U) \$1,482	<ul style="list-style-type: none"><li>(U) Evaluate integrated EO sensor system components and assess for automatic target recognition capability.</li><li>(U) Use field test data to fabricate an airborne EO sensor which can operate in day or night and across multiple optical bands.</li><li>(U) Complete design and initiate fabrication of an EO target detection and ID sensor that increases ID range ten-fold.</li></ul> Develop and demonstrate radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures.		
- (U) \$3,543	<ul style="list-style-type: none"><li>(U) Continue to develop electronic protection techniques against emerging threats, including application of neural nets to identify and remove jamming waveforms, and use real radar imagery to assess improvements.</li></ul> Develop processing techniques to negate clutter and electromagnetic interference, both intentional and unintentional, for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets.		
- (U) \$3,253	<ul style="list-style-type: none"><li>(U) Conduct laboratory/rooftop demonstration of advanced clutter/interference mitigation techniques for restoring high performance air-to-air and air-to-ground radar capabilities in severe jamming and interference environments.</li></ul> Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques.		
- (U) \$882	<ul style="list-style-type: none"><li>(U) Ground test and evaluate real-time image formation/interference mitigation algorithms for all-weather, foliage-penetration synthetic aperture radar.</li><li>(U) Ground test and evaluate target detection algorithms for detecting ground targets obscured by foliage and/or camouflage.</li></ul> Develop critical components required to lower life cycle cost of current and future radar systems.		
- (U) \$11,332	<ul style="list-style-type: none"><li>(U) Conduct flight test of affordable antenna suitable for unmanned aerial vehicles.</li><li>(U) Develop dual-use, low-cost radar technology enhancements for application to current frontline fighters.</li></ul> Total		

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Exhibit R-2 (PE 0603203F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT															
BUDGET ACTIVITY	PE NUMBER AND TITLE																	
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles		665A															
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>11,326</td> <td>12,380</td> <td>11,314</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>12,307</td> <td>11,707</td> <td>11,332</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation: Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&amp;T) Program. Schedule: Not Applicable. Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0603205F, Flight Vehicle Technology.</li> <li>- (U) PE 0603707F, Weather Systems Advanced Development.</li> <li>- (U) PE 062111N, Weapons Technology.</li> <li>- (U) PE 062232N, Space and Electronic Warfare (SEW) Technology.</li> <li>- (U) PE 0604249F, LANTIRN Night Precision Attack.</li> <li>- (U) PE 0603270F, Electronic Combat Technology.</li> <li>- (U) A memorandum of agreement has been established between the Air Force Wright Laboratory and the Defense Advanced Research Projects Agency (DARPA) to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments including deception, camouflage, concealment, and deep hide. This technology also has significant application in the civil sector. DARPA and the Air Force will collaborate with civil agencies where appropriate.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	11,326	12,380	11,314	Cost	(U) Current Budget Submit/FY 1999 PB	12,307	11,707	11,332	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	11,326	12,380	11,314	Cost														
(U) Current Budget Submit/FY 1999 PB	12,307	11,707	11,332	Cont														

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE							
BUDGET ACTIVITY		PROJECT							
3 - Advanced Technology Development		69CK							
PE NUMBER AND TITLE		0603203F Advanced Avionics for Aerospace Vehicles							
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
69CK Advanced Electronics	3,273	1,450	1,568	1,071	1,234	1,246	1,442	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates military specific microelectronic devices, tools, and components that improve performance, reliability, and affordability of radar, communications, and electronic counter-measure systems for both retrofit and new system applications. Results of the work provide the warfighter with increased sensor capabilities in terms of increased situational awareness, higher accuracy detection and tracking of targets/threats at longer ranges, more precise weapon employment, and increased affordability. This project develops electronics technologies unavailable from commercial sources and includes development of: monolithic solid state transmit/receive modules for airborne radar; high-speed analog-to-digital converters; high reliability electronics power distribution; and microwave/microelectronics packaging and interconnect techniques.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,551 Develop advanced microelectronics component, power distribution, packaging, and interconnect technologies to provide for reduction in power consumption, cost, weight, and volume of target detection electronics.
- (U) Demonstrated reliability of inorganic chip seal process that reduces size and cost of packaging for target detection electronics.
- (U) Fabricated and tested advanced power modules for improved efficiency and reliability in phased array radar systems.
- (U) \$1,060 Develop advanced component technologies to integrate multi-function microwave and millimeter wave circuits for reduced airborne sensor cost, weight, and volume, and improved reliability of radar and targeting electronics.
- (U) Demonstrated initial driver and booster amplifier designs; completed final design of low-band microwave power module.
- (U) \$662 Develop advanced multi-function sensor electronics, including integrated analog/digital elements (both radio frequency (RF) and electro-optical), to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
- (U) Selected analog/digital microwave receiver designs which offer greatest overall improvement in cost and performance and initiate development.
- (U) Developed affordable high performance RF device and packaging technologies which minimize the number of components and size of transmit/receive modules for use in phased array multi-function sensors on manned and unmanned platforms.
- (U) \$3,273 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603203F Advanced Avionics for Aerospace

69CK

Vehicles

## (U) FY 1998 (\$ in Thousands):

- (U) \$545 Develop advanced microelectronics components, power distribution, packaging, and interconnect technologies to reduce power consumption, cost, weight, and volume of emerging military systems such as target detection and tracking electronics.
- (U) Demonstrate a capability to apply advanced inorganic coatings for the encapsulation of integrated circuits to achieve a ten times reduction in packaging costs while realizing weight savings and performance improvements.
- (U) Continue development of advanced power supplies with improved efficiency and reliability needed for both analog and digital components used in multi-function phased array radar systems.
- (U) \$557 Develop advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
- (U) Optimize very high-speed digital assemblies that can replace multiple analog assemblies in fighter aircraft radar applications to reduce system volume, complexity, and life cycle costs.
- (U) Continue development of affordable, high performance radio frequency (RF) circuits and packaging technologies for minimum size transmit/receive modules for use in phased array antenna multi-function RF sensors on manned and unmanned platforms.
- (U) Demonstrate a miniature analog/digital microwave receiver with improved performance and reduced cost.
- (U) \$348 Develop advanced design automation tools and methods for creating complex electronics/avionics. These tools will significantly lower the development cost and subsequent support costs of all electronic systems.
- (U) Demonstrate the speed of automated design tools by designing an integrated circuit board for fighter cockpit applications.
- (U) \$1,450 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$1,568 Develop advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance, and decrease cost, weight, and volume in integrated airborne avionics.
- (U) Continue to develop very high-speed digital assemblies that can replace multiple analog assemblies in applications such as fighter aircraft radars to reduce system volume, complexity, and life cycle costs.
- (U) Fabricate and test miniature, high performance RF/digital multichip assemblies to increase jam-resistance of multichannel RF sensor receivers.
- (U) Initiate design of miniature, all-digital, microwave receiver components with improved performance and reduced costs.
- (U) \$1,568 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603203F Advanced Avionics for Aerospace

69CK

Vehicles

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	3,368	1,532	3,078	Cost
	3,273	1,450	1,568	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603270F, Electronic Combat Technology.
- (U) PE 0603739E, Electronic Manufacturing Technology.
- (U) PE 0603706E, Microwave/Millimeter Wave Integrated Circuits.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603203F Advanced Avionics for Aerospace

PROJECT

69DF

Vehicles

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
69DF Target Attack and Recognition Technology		12,660	11,920	13,542	13,575	14,182	14,177	14,523	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition capabilities. The objective of this project includes developing and demonstrating integrated fire control techniques to provide for a capability of adverse-weather air-to-surface precision strike against multiple targets-per-pass and air-to-air engagement at maximum weapon launch range with cooperative launch deployment flexibility. Specific fire control technologies include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. These fire control developments will provide force multiplication and a reduction of exposure to hostile fire. The objectives of this project also include developing and demonstrating technologies to provide for positive, high confidence cueing, recognition, and identification of both airborne and ground-based, high-value, time-critical targets at ranges compatible with tactical air-to-air and air-to-surface weapons in bad weather, day or night, and in high-threat multiple target battle areas. Model-based vision algorithms and target signature development techniques are key to the identification and recognition solution and are pursued in this project in partnership with the Defense Advanced Research Projects Agency. The techniques developed are evaluated to support the Theater Missile Defense efforts in surveillance and attack. The fire control and recognition technologies developed and demonstrated in this project are high leverage in that they provide for significant advancements in operational capabilities largely through software improvements which can be readily transitioned to new and existing systems.

## (U) FY 1997 (\$ in Thousands):

- (U) \$2,882 Develop synthetic signature capability for ground targets to train automatic target recognition algorithms.
- (U) Demonstrated capability to rapidly insert synthetic signatures of new targets into automatic target recognition sensor algorithms.
- (U) Evaluated tactical target models under camouflage and partial obscuration conditions.
- (U) \$1,959 Evaluate algorithms, including model-based vision algorithms, for moving and stationary target acquisition and recognition and for theater missile defense surveillance and attack efforts.
- (U) Demonstrated and evaluated maturity of end-to-end algorithms, including moving and stationary target acquisition, for insertion into theater missile defense demonstration efforts.
- (U) \$1,418 Develop advanced hostile target identification technologies to provide a capability for beyond-visual-range, all aspect, high confidence classification and identification of airborne targets.
- (U) Continued to demonstrate synthetic signature generation capability to support fielded automatic target recognition systems.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603203F Advanced Avionics for Aerospace Vehicles

PROJECT

69DF

- (U) \$283 Develop advanced air-to-air engagement and weapon delivery technologies to provide for a beyond-visual-range detection, targeting, and weapon deployment capability against sophisticated and reduced observable airborne threats.
  - (U) Developed cooperative engagement subsystem technology for fighter weapon systems.
  - (U) Evaluated cooperative engagement and tracking accuracy development for air-to-air weapon deployment through continued simulation and ground-based experiments.
- (U) \$591 Develop advanced information fusion technologies to increase air engagement situation awareness and lethality through: longer-range, high confidence identification; integration of offensive and defensive sensor technology; and exploitation of off-board targeting information.
  - (U) Completed ground-to-air testing at the Radar Test Facility of multispectral radar signal fusion techniques.
  - (U) Integrated multispectral radar signal fusion into airborne data collection system.
  - (U) Collected airborne data and analyzed multispectral radar signature fusion technologies.
- (U) \$2,658 Develop advanced tracking algorithms to increase detection range of conventional threats and maintain detection range against low cross section threats. This effort will also increase identification range of airborne threats.
  - (U) Continued to collect airborne data to evaluate the increase in identification range provided by advanced tracking algorithms versus existing tracking systems.
- (U) \$2,869 Develop technologies for targeting both stationary and moving ground-based threats with precision, utilizing both on-board and off-board targeting information. These technologies provide the targeting solution required to release air-to-surface weapons.
  - (U) Completed performance evaluation of advanced targeting techniques using real-time, off-board information.
  - (U) Completed analysis of off-board targeting concepts and provide option to transition to operational aircraft.
- (U) \$12,660 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$3,688 Develop and demonstrate advanced air-to-air detection, tracking, identification, and engagement technologies to provide beyond-visual-range, all-aspect, high confidence classification, identification, targeting, and all-aspect weapon deployment against conventional and reduced-signature airborne threats.
  - (U) Complete development and transition of turnkey synthetic signature generation capability to support hostile airborne target identification program.
  - (U) Investigate the use of advanced sensor suites and off-board sources for long-range, high-confidence identification of airborne targets.
  - (U) Develop preliminary design for all-aspect fire control system based on integration of offensive and defensive sensors.
  - (U) Complete ground-to-air testing of radar fusion techniques for combining radar identification modes.

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Exhibit R-2 (PE 0603203F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT		
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles	69DF		
- (U) \$2,225	Develop and demonstrate advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability through: integration of offensive and defensive sensor technology; exploitation of off-board threat and targeting information; and timely usage of Real-Time Information Out of the Cockpit (RTOC).			
	- (U) Design a RTOC approach to improve operational battle damage assessment effectiveness.			
	- (U) Demonstrate embedded multi-source fusion subsystem to integrate electronic intelligence information with synthetic aperture radar imagery at reconnaissance stations.			
- (U) \$6,007	- (U) Develop concept for real-time embedded multi-source fusion system to vastly improve tactical aircraft situational awareness. Develop and demonstrate innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase capacity to detect, identify, and target hostile ground forces.			
	- (U) Develop an integrated ATR/fusion algorithm design testbed to enable multi-sensor ATR and identification for both reconnaissance/intelligence and strike platforms.			
	- (U) Demonstrate and evaluate current algorithms for air-to-ground, high range resolution algorithm that supports the longer radar timelines of reconnaissance radar.			
	- (U) Measure performance of air-to-ground ATR algorithms using enhanced radar, third generation forward-looking infrared (FLIR), and multi-spectral ATR data.			
	- (U) Complete critical design of hardware and software modifications to a fire control radar needed for an advanced capability to identify friendly and hostile ground forces.			
- (U) \$11,920	Total			
(U) FY 1999 (\$ in Thousands):				
- (U) \$1,983	Develop and demonstrate advanced air-to-air detection, tracking, identification, and engagement technologies to provide beyond-visual-range, all-aspect, high confidence classification, identification, targeting, and all-aspect weapon deployment against conventional and reduced-signature airborne threats.			
	- (U) Continue investigation of advanced sensor suites and off-board sources for long-range, high-confidence identification of airborne targets.			
	- (U) Analyze ground test data and make necessary modifications to radar fusion techniques for combining radar identification modes.			
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603203F Advanced Avionics for Aerospace Vehicles	69DF	
- (U) \$6,663	Develop and demonstrate advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability through: integration of offensive and defensive sensor technology; exploitation of off-board threat and targeting information; and timely usage of Real-Time Information Out of the Cockpit (RTOC).		
	- (U) Continue to demonstrate embedded multi-source fusion subsystem to integrate electronic intelligence information with synthetic aperture radar (SAR) imagery at reconnaissance stations.		
	- (U) Flight demonstrate real-time rerouting of an F-117 using Real-Time Information In the Cockpit (RTIC) technology.		
	- (U) Develop and flight test fusion of SAR and forward looking infrared (FLIR) algorithms on an F-15E to demonstrate improved target detection and recognition of time critical targets.		
- (U) \$4,896	Develop and demonstrate innovative air-to-ground Automatic Target Recognition (ATR) and identification technologies to increase capacity to detect, identify, and target hostile ground forces.		
	- (U) Continue to develop an integrated ATR/fusion algorithm design testbed to enable multi-sensor ATR and identification for both reconnaissance/intelligence and strike platforms.		
	- (U) Downselect and integrate optimal algorithm that supports the longer timelines of reconnaissance radars and improves air-to-ground, high range resolution.		
	- (U) Perform detailed performance analysis of air-to-ground ATR algorithms using enhanced radar, third generation FLIR, and multi-spectral ATR data.		
	- (U) Begin hardware and software modifications to a fire control radar to demonstrate advanced capability for identification of friendly and hostile ground forces.		
- (U) \$13,542	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603203F Advanced Avionics for Aerospace

69DF

Vehicles

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	12,781	12,595	13,814	Cost
(U) Current Budget Submit/FY 1999 PB	12,660	11,920	13,542	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603253F, Advanced Avionics Integration.
- (U) PE 0603726E, Sensor and Guidance Technology
- (U) Theater Missile Defense System Program Office.
- (U) Low Altitude Night Targeting and Infrared Navigation (LANTRN) System Program Office.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603205F

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PE TITLE: Flight Vehicle Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603205F Flight Vehicle Technology									
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		8,734	5,441	7,035	7,476	7,043	7,017	6,562	Continuing	Continuing	
2978 Flight Vehicle Technologies		6,605	4,231	5,172	6,084	5,791	5,961	6,188	Continuing	Continuing	
4398 Air Base Technology		2,129	1,210	1,863	1,392	1,252	1,056	374	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced vehicle subsystems, aerodynamic/flight controls, and vehicle-pilot integration technologies for improved performance, improved survivability, and reduced logistics support. This program also demonstrates technologies for fixed and bare base assets, including airfield pavements, energy systems, automation, air base survivability, air base recovery, protective systems, fire protection, and crash rescue. Note: FY 1998 decrease reflects reduced investments in aircraft tire, landing gear, and airbase operations technologies.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		
3 - Advanced Technology Development		0603205F Flight Vehicle Technology		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>				
(U) Previous President's Budget (FY 1998 PB)				
(U) Appropriated Value				
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions				
b. SBIR				
c. Omnibus/Other Above Threshold Reprogrammings				
d. Below Threshold Reprogrammings				
e. Rescissions				
(U) Adjustments to Budget Year Since FY1998 PB				
(U) Current Budget Submit/FY 1999 PB				
(U) Change Summary Explanation:				
Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on flight vehicle technologies within the Science and Technology (S&T) Program. Below Threshold Reprogramming was used to complete aircraft tire and landing gear efforts necessary for transition of technology development work scheduled to be significantly reduced beginning in FY 1998.				
Schedule: Not Applicable.				
Technical: Not Applicable.				
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.				
(U) D. <u>Schedule Profile:</u> Not Applicable.				

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603205F Flight Vehicle Technology

PROJECT

2978

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2978	Flight Vehicle Technologies	6,605	4,231	5,172	6,084	5,791	5,961	6,188	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program designs, develops, and demonstrates air vehicle technologies for improved performance, reliability, maintainability, and supportability while increasing affordability, survivability, and mission effectiveness. It is focused on exploiting advancements in air vehicle component and subsystem technologies, aerodynamic/flight control technologies, and vehicle-pilot integration technologies.

(U) FY 1997 (\$ in Thousands):

- (U) \$5,785 Develop and demonstrate advanced/integrated air vehicle component subsystems and vehicle-pilot integration technologies to reduce volume, weight, complexity, and cost of required spares through improved reliability, affordability, and maintainability.
- (U) Completed development and demonstration of the computational system to quantitatively predict life cycle environmental conditions for air vehicles and external stores and make available for transition to System Program Office and Air Logistics Center users.
- (U) Completed the development and demonstration of an advanced fighter aircraft main tire compound and tread design suitable for today's fleet and for future aircraft upgrades which have significantly longer lifetime and reduced logistics/deployment requirements.
- (U) Correlated advanced analytical model predictions with realistic operational load measurements of tread wear obtained from the unique air vehicle tire wear assessment system; established the baseline for using new tire design technology to obtain extended tire life.
- (U) Developed and demonstrated advanced radial tire retreading technology for current and future fighter aircraft applications; established the cost benefits and determine the reliability of retread tire technology for aircraft tire usage.
- (U) \$244 Develop on-board software for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and vehicle-pilot integration in order to reduce pilot workload when off-board information enters the cockpit.
- (U) \$576 Develop and demonstrate advanced air vehicle and flight control concepts to provide a combat advantage for the next generation aircraft by increasing performance and survivability while decreasing both cost and supportability requirements.
- (U) Completed flight tests of both the electrohydrostatic aileron actuator on an F/A-18 aircraft which will establish a baseline for totally eliminating hydraulic fluid from flight control actuation.
- (U) Assessed future fighter aircraft development requirements to identify design and test opportunities which can exploit the application of advanced electric flight control technologies to effectively reduce aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.
- (U) Designed innovative intelligent controller for flight controller actuator that senses air data to predict loads, reducing actuator performance requirements.
- (U) \$6,605 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603205F Flight Vehicle Technology	2978	
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,334	Develop revolutionary Future Aircraft Technology Enhancements (FATE) by integrating high payoff air vehicle technologies that address and optimize synergistic benefits.		
-	(U) Completed evaluation of enhanced fighter tire life through aircraft testing and correlation with unique air vehicle tire wear assessment system and analytical model predictions for current and future aircraft application.		
-	(U) Continued developing on-board software for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and vehicle-pilot integration.		
- (U) \$462	Develop software for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike vehicles for air combat operations.		
- (U) \$1,435	Develop and demonstrate advanced integrated air vehicle subsystems to provide increased performance and survivability while decreasing both cost and supportability requirements.		
-	(U) Developed a flight worthy electric stabilator actuator design for future flight demonstration testing that exploits advanced electric flight control technologies to effectively reduce aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.		
-	(U) Demonstrated structural integrity of injection molded frameless fighter aircraft windshields to improve aircraft range and optics performance while lowering cost. Make this technology available for further risk reduction and application to current and future fighter aircraft.		
- (U) \$4,231	Total		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603205F Flight Vehicle Technology</b>	<b>2978</b>	

  

U) FY 1999 (\$ in Thousands):

- (U) \$2,405 Develop revolutionary Future Aircraft Technology Enhancements (FATE) by integrating high payoff air vehicle technologies that address and optimize synergistic benefits.
- (U) Integrate display designs for automatic in-flight mission re-planning, trajectory generation, flight control coupling, and cockpit controls in order to reduce pilot workload when off-board information enters the cockpit.
- (U) Develop conceptual design for low-cost advanced aerodynamic flight demonstrator.
- (U) \$987 Develop algorithms for multiple ship integrated control strategies to enable the safe and effective cooperative employment of manned and unmanned strike vehicles for air combat operations.
- (U) \$1,780 Develop and demonstrate advanced integrated air vehicle subsystems to provide increased performance and survivability while decreasing both cost and supportability requirements.
- (U) Fabricate a flight critical electric stabilator actuator for flight demonstration in an F/A-18 aircraft to enable advanced electric flight control technologies for reducing aircraft weight, ground support equipment, and maintenance while improving aircraft reliability.
- (U) \$5,172 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603205F Flight Vehicle Technology</b>	<b>2978</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>5,920</td> <td>4,484</td> <td>4,276</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>6,605</td> <td>4,231</td> <td>5,172</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to increased emphasis on flight vehicle technologies within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>- (U) PE 0603216F, Aerospace Propulsion and Power.</li> <li>- (U) PE 0603245F, Flight Vehicle Technology Integration.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	5,920	4,484	4,276	Cost	(U) Current Budget Submit/FY 1999 PB	6,605	4,231	5,172	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	5,920	4,484	4,276	Cost														
(U) Current Budget Submit/FY 1999 PB	6,605	4,231	5,172	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603205F Flight Vehicle Technology

4398

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4398 Air Base Technology	2,129	1,210	1,863	1,392	1,252	1,056	374	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops technologies for fixed and bare base operations, including airfield pavements, energy systems, air base survivability, air base recovery, protective systems, fire protection, and crash rescue.

## (U) FY 1997 (\$ in Thousands):

- (U) \$878 Develop and demonstrate technologies for improved bare base and fixed site applications (e.g., survivable air base structures and durable or repairable airfield surfaces).
  - (U) Completed development of man-portable ground penetrating radar for bare base contingency runway conditions.
  - (U) Assessed advanced hardening techniques and processes for upgrading existing air base buildings and assets.
  - (U) Completed development of protective systems using in-theater materials to harden critical air base assets in contingency operations.
  - (U) Demonstrated deployable pavement evaluation techniques for rapid assessment of bare base runway conditions.
- (U) \$776 Develop aircraft and air base fire fighting technologies (e.g., clean, environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems).
  - (U) Continued development of advanced hypergolic vapor and fuel fire detection/suppression technologies.
  - (U) Demonstrated performance of environmentally acceptable aqueous film forming foam, a replacement agent for Halon.
  - (U) Completed large frame aircraft fire fighting program to aid in extinguishing external and internal fires of transport aircraft.
  - (U) Developed advanced fire crash and rescue vehicle technologies to assist fire fighters in search and rescue operations.
  - (U) Developed vision enhancement technologies to assist fire fighters in search and rescue operations.
- (U) \$475 Develop aircraft power generation technologies (e.g., lightweight generator systems and advanced fuel cells).
  - (U) Demonstrated conversion of bare base waste stream into an energy source.
  - (U) Conducted field tests of brassboard for advanced cycle mobile heat pump.
  - (U) Completed development of control improvements in backup power generation systems.
- (U) \$2,129 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603205F Flight Vehicle Technology	February 1998	4398
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,210	Develop aircraft and air base fire fighting technologies (e.g., environmentally-safe fire fighting agents, vehicles, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems).		
	- (U) Developed microencapsulated phase change materials for thermal barrier for fire fighting ensembles.		
	- (U) Completed development of biodegradable aqueous film forming foam replacement.		
	- (U) Developed fire threat versus response capability model.		
- (U) \$0	Develop aircraft and air base fire fighting technologies (e.g., utilities and shelters) that improve air mobile systems performance and reduce airlift requirements in support of Air Expeditionary Force (AEF) operations.		
	- (U) Continued development of prototype acoustic cycle heat pump.		
	- (U) Developed advanced hardening techniques to protect existing contingency air base buildings and assets.		
- (U) \$1,210	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$700	Develop aircraft and air base fire fighting and power generation technologies (e.g., clean environmentally safe fire fighting agents, equipment, personnel protective clothing, fire risk assessment techniques, and fire fighter training systems).		
	- (U) Develop virtual reality fire fighter training technology to provide cost effective, realistic training and protect the environment.		
	- (U) Complete microencapsulated phase change materials for thermal barrier for firefighter ensembles		
	- (U) Complete development of fire threat versus response capability model.		
- (U) \$1,163	Develop technologies (i.e., utilities and shelters) that improve air mobility systems performance and reduce airlift requirements in support of Air Expeditionary Forces (AEF) operations.		
	- (U) Complete development of a prototype acoustic cycle heat pump.		
	- (U) Fabricate a prototype logistics fuel reformer for AEF applications.		
	- (U) Construct and air transportable shelter advanced development model for field testing.		
- (U) \$1,863	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603205F Flight Vehicle Technology

4398

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	2,132	1,282	2,166	Cost
	2,129	1,210	1,863	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to increased emphasis on flight vehicle technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603307F, Air Base Operability Advanced Technology Development.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603211F

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PE TITLE: Aerospace Structures

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE	February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE						PROJECT		
3 - Advanced Technology Development		0603211F Aerospace Structures						486U		
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
486U	Advanced Aerospace Structures	9,398	9,734	12,494	14,435	15,041	16,434	16,932	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops and demonstrates affordable aircraft structures by utilizing innovative metallic and composite structures technologies to reduce the cost of airframe ownership. Innovative structural concepts integrate these two types of materials with design and monitoring techniques to develop and demonstrate solutions and repairs for corrosion fatigue, multi-site damage fatigue, and other damage to which aging aircraft are susceptible. The goal of this program is to develop technologies to restore structural integrity, extend life, and improve survivability of the current fleet. The results are less maintenance intensive, more durable, and more dependable structures for current aerospace systems. This yields lower cost of ownership (by delaying acquisition and by reducing support and maintenance costs), restored and improved sortie rates (due to durability, damage or threat tolerance, and design for supportability), and reduced observability (both radar cross section and infrared). Note: In FYs 1998 and out, additional emphasis has been placed on aerospace structures technology to meet user needs identified by the Air Force aging aircraft initiative to extend the life of existing operational aircraft.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603211F Aerospace Structures</b>		<b>486U</b>
(U) FY 1997 (\$ in Thousands):			
- (U) \$1,529	Develop and assess processes for extending the structural life of aircraft.		
	- (U) Conducted ground testing of an installed wing spar for replacement of corrosion-sensitive components in an existing aircraft.		
	- (U) Developed preliminary corrosion fatigue predictive models which incorporate observed corrosion phenomenon of operational aircraft structures to better assess structural integrity, life, and intervals of inspection for corrosion affected components in existing aircraft.		
	- (U) Developed composite repair processes for damaged and cracked metallic components for existing aircraft applications.		
	- (U) Demonstrated built-in structural health monitoring in a full-scale fighter bulkhead; evaluated for capability to automate crack growth inspections and, thereby, reduce structural maintenance, repair, and replacement costs.		
- (U) \$2,026	Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.		
	- (U) Completed laboratory testing of small metallic, exhaust-impinged aft fuselage subcomponents and fabricated a larger subcomponent to overcome structural failures of components in severe thermal and acoustic environments.		
	- (U) Completed testing of an advanced wing box component on a military aircraft airframe subject to extreme, high temperatures and assessed its impact on aircraft survivability.		
	- (U) Completed preliminary design of an integrated aft fuselage and nozzle section structure to reduce weight and improve aircraft performance.		
- (U) \$5,409	Develop advanced structural concepts and design methods for future and existing air vehicles.		
	- (U) Conducted detailed design of aircraft structural component to demonstrate significant increase in survivability of existing military aircraft.		
	- (U) Completed detailed design of sandwich structures that reduce weight and cost in aircraft primary structure applications.		
	- (U) Completed durability and damage testing of a composite fuselage structure which will reduce manufacturing costs by 50% and supportability costs by 25%.		
	- (U) Completed preliminary design of a flexible wing that twists to control flight, significantly improving maneuverability and range, and reducing air vehicle structural weight.		
	- (U) Completed detailed design of an advanced, affordable airframe that maximizes use of composite structures.		
- (U) \$434	Develop advanced airframe concepts which integrate structures with distributed actuators and sensors.		
	- (U) Completed ground test of conformal, load bearing antenna structure which reduces cost, weight, drag, and enhances low-observable characteristics while providing new and improved antenna performance.		
- (U) \$9,398	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603211F Aerospace Structures

PROJECT

486U

(U) FY 1998 (\$ in Thousands):

- (U) \$3,956	Develop and assess processes for extending the structural life of aircraft.
- (U) \$1,302	<ul style="list-style-type: none"> <li>- (U) Complete ground and flight tests of a wing spar to demonstrate replacement of corrosion-sensitive components in an existing aircraft.</li> <li>- (U) Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.</li> <li>- (U) Complete laboratory testing of a large metallic, exhaust-impinged aft fuselage subcomponent to overcome structural failures in severe thermal and acoustic environments.</li> <li>- (U) Complete detailed design of an integrated aft fuselage and nozzle section structures to reduce weight and improve aircraft performance.</li> </ul>
- (U) \$4,476	<ul style="list-style-type: none"> <li>- (U) Develop advanced structural concepts and design methods for future and existing air vehicles.</li> <li>- (U) Complete detailed design of sandwich structure component that reduces weight and cost in aircraft primary structure applications.</li> <li>- (U) Complete development of flight computer software for flight demonstration of a flexible wing that twists to control flight, significantly improving maneuverability, increasing range, and reducing air vehicle structural weight.</li> <li>- (U) Identify new analysis methods and design criteria for advanced composite structures.</li> <li>- (U) Complete ground testing of a composite wing structure which will reduce manufacturing costs by 50% and supportability costs by 25%.</li> </ul>
- (U) \$9,734	Total

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY <b>3 - Advanced Technology Development</b>		PROJECT <b>486U</b>
PE NUMBER AND TITLE <b>0603211F Aerospace Structures</b>		
(U) FY 1999 (\$ in Thousands):		
- (U) \$6,317	Improve durability and performance of vehicle structures operating in extreme thermal and acoustic environments.	
- (U) \$6,177	- (U) Complete fabrication of an integrated aft fuselage and nozzle section structures to reduce weight and improve aircraft performance. Develop advanced structural concepts and design methods for future and existing air vehicles.	
	- (U) Fabricate a full-scale structural component to demonstrate significant increase in survivability of existing military aircraft.	
	- (U) Conduct ground testing of sandwich structural component that reduces weight and cost in aircraft primary structure applications.	
	- (U) Complete modification of an aircraft for flight demonstration of a flexible wing that twists to control flight, significantly improving maneuverability and range, and reducing air vehicle structural weight.	
	- (U) Develop and apply new analysis methods and design criteria to advance composite structures to reduce life cycle costs by maximizing use of composite structures.	
- (U) \$12,494	Total	

Project 486U

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603211F Aerospace Structures

PROJECT

486U

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Appropriated Value	9,945	15,032	17,745	Cost
(U) Adjustments to Appropriated Value	10,423	10,423		Cont
a. Congressional/General Reductions	-220	-437		
b. SBIR	-258	-252		
c. Omnibus/Other Above Threshold Reprogrammings	-131			
d. Below Threshold Reprogrammings	-400			
e. Rescissions	-16			
(U) Adjustments to Budget Year Since FY1998 PB	9,398	9,734	-5,251	
(U) Current Budget Submit/FY 1999 PB			12,494	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 486U

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Exhibit R-2 (PE 0603211F)

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PE NUMBER: 0603216F

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PE TITLE: Aerospace Propulsion and Power Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603216F Aerospace Propulsion and Power Technology									
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		34,464	33,126	38,984	40,524	42,132	42,128	43,864	Continuing	Continuing	
2480 Aerospace Fuels and Atmospheric Propulsion		2,969	1,533	2,059	2,250	2,212	3,151	3,264	Continuing	Continuing	
3035 Aerospace Power Systems Technology		2,601	3,472	3,399	3,823	3,959	4,180	4,355	Continuing	Continuing	
681B Advanced Turbine Engine Gas Generator		28,894	28,121	33,526	34,451	35,961	34,797	36,245	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0
<p>Note: Beginning in FY 1998, Project 2480, Aerospace Fuels Technology, and Project 2697, Atmospheric Propulsion Concepts, are combined into a single project, Project 2480, Aerospace Fuels and Atmospheric Propulsion. The total PE costs shown for FY 1997 reflect this consolidation.</p> <p>(U) A. <u>Mission Description and Budget Item Justification:</u> This Advanced Technology Development program develops and demonstrates affordable turbine engine high pressure core components, advanced airbreathing engine concepts, high heat sink and thermally stable fuels, and power technology for aerospace vehicles. Anticipated technology advances include turbine engine improvements providing a 33% reduction in aircraft takeoff gross weight for tactical fighter aircraft and a 100% increase in aircraft range/loiter; ducted rocket improvements that increase missile average and terminal velocity by 50% and range by 100% for enhanced lethality; higher temperature fuels for propulsion and thermal management; an aircraft battery with a 20-year maintenance-free life expectancy; and electric aircraft power components projected to provide a two- to five-fold improvement in reliability and maintainability, a 20% reduction in power system weight, and enhanced survivability. Note: FY 1998 and out increases in Project 3035, Aerospace Power Systems Technology, reflect demonstration of the aircraft electric power distribution system.</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		February 1998
PE NUMBER AND TITLE		
3 - Advanced Technology Development		
Technology		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	36,506	37,014
(U) Adjustments to Appropriated Value	38,264	35,183
a. Congressional/General Reductions	-801	-1,148
b. SBIR	-957	-909
c. Omnibus/Other Above Threshold Reprogrammings	-1,982	
d. Below Threshold Reprogrammings		
e. Rescissions	-60	
(U) Adjustments to Budget Year Since FY 1998 PB		
(U) Current Budget Submit/FY 1999 PB	34,464	33,126
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.		
(U) D. <u>Schedule Profile:</u> Not Applicable.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603216F Aerospace Propulsion and Power

2480

Technology

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2480 Aerospace Fuels and Atmospheric Propulsion	2,969	1,533	2,059	2,250	2,212	3,151	3,264	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Develops and demonstrates new thermally stable and high heat sink fuels and advanced fuel system components that minimize cost, reduce maintenance, and improve performance of aircraft and missiles. Emphasis is on demonstrating the effects/benefits of JP-8+100 on current systems, and advanced high temperature fuel system designs and components on upgraded and advanced systems. Demonstrates unconventional airbreathing propulsion subsystems such as ramjets, air turbo-rockets, dual-mode ramjets, and combined/advanced-cycle engines to assure future propulsion options for high-speed missiles.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,281 Demonstrated thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) Demonstrated effects/benefits of JP-8+100 in component and engine stand tests of T64, F101, and TF53 engines.
- (U) Demonstrated reduced fuel system maintenance in aircraft (T-37, T-38, C-130) by conducting field trial of JP-8+100 at selected bases.
- (U) \$208 Demonstrated advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
- (U) Demonstrated high heat sink fuel capacity of JP8+100 in a reduced-scale fuel/air heat exchanger designed to replace less efficient ram air/fuel heat exchangers for engine cooling in upgraded systems.

Project 2480

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603216F Aerospace Propulsion and Power Technology	2480	
- (U) \$1,380	Developed Variable Flow Ducted Rocket (VFDR) for airbreathing missile applications. This effort transitions technology to current and future tactical missiles providing longer range, higher velocities, and increased maneuverability, resulting in improved overall missile effectiveness.		
	- (U) Completed rocket-to-ramjet mode transition and performance documentation testing to demonstrate technology maturity for advanced missile propulsion applications.		
	- (U) Completed ground technology demonstration of VFDR technology and document results.		
- (U) \$100	Developed and demonstrated the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications. This effort provides technology at lowered risk for future missile systems where time-to-target is critical and provides technology for next generation reconnaissance/strike vehicles and airbreathing boosters.		
	- (U) Planned design/development of dual-mode ramjet engines for high-speed missiles for destroying high value, time-critical targets.		
	- (U) Planned design/development of combined/advanced-cycle engines for manned and unmanned high-speed vehicles applicable to reconnaissance/strike missions.		
	- (U) Completed preliminary scramjet critical loads assessment.		
- (U) \$2,969	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$940	Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.		
	- (U) Demonstrate effects/benefits of second JP-8+100 thermal stability additive package in component and engine stand tests.		
- (U) \$193	Demonstrate effectiveness of thermally stable JP-8+100 for reduced maintenance in variety of aircraft.		
	- (U) Demonstrate reduced fuel system maintenance in B-1 and C-141 aircraft and in HH-53, H-1, and HH-60 helicopters by conducting field trials of JP-8+100 at selected bases.		
- (U) \$340	Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.		
	- (U) Complete design and evaluation of upgraded F-15 fuel system modifications that permit utilization of increased cooling capacity of JP-8+100.		
- (U) \$60	Complete final documentation on VFDR technology and concepts.		
- (U) \$1,533	Total		

Project 2480

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Exhibit R-2 (PE 0603216F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603216F Aerospace Propulsion and Power

2480

## Technology

## (U) FY 1999 (\$ in Thousands):

- (U) \$1,437 Demonstrate thermally stable JP-8+100 and high heat sink fuels that reduce fuel system maintenance on current aircraft and provide greater cooling capacity (performance) for upgraded and future aircraft and missiles.
- (U) Demonstrate effects/benefits of JP-8+100 in Integrated High Performance Turbine Engine Technology (IHPTET) Phase II demonstrator.
- (U) \$211 Demonstrate effectiveness of thermally stable JP-8+100 for reduced maintenance in variety of aircraft.
- (U) \$311 Complete field trials of JP-8+100.
- (U) \$100 Demonstrate advanced fuel system designs and high temperature components that permit utilization of the increased cooling capacity of JP-8+100 and high heat sink fuels.
- (U) Design high heat sink fuel/air heat exchanger suitable for incorporation into IHPTET Phase III demonstrator.
- (U) Develop and demonstrate the design and construction of critical high-speed propulsion components/structures for manned and unmanned applications. This effort provides technology at lowered risk for future missile systems where time-to-target is critical and provides technology for next generation reconnaissance/strike vehicles and airbreathing boosters.
- (U) Design critical high temperature structures for high speed unmanned applications.
- (U) \$2,059 Total

Project 2480

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
3 - Advanced Technology Development	0603216F Aerospace Propulsion and Power Technology	2480																
<p>(U) B. <u>Program Change Summary (\$ in Thousands)</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>4,025</td> <td>1,625</td> <td>2,145</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>2,969</td> <td>1,533</td> <td>2,059</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:            - (U) PE 0602203F, Aerospace Propulsion.            - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	4,025	1,625	2,145	Cost	(U) Current Budget Submit/FY 1999 PB	2,969	1,533	2,059	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	4,025	1,625	2,145	Cost														
(U) Current Budget Submit/FY 1999 PB	2,969	1,533	2,059	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603216F Aerospace Propulsion and Power

PROJECT

3035

Technology

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3035 Aerospace Power Systems Technology	2,601	3,472	3,399	3,823	3,959	4,180	4,355	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates aircraft and ground power systems including engine starters, auxiliary power units, and electrical power distribution systems. The principal focus is to provide a two- to five-fold improvement in reliability and maintainability and significantly reduced cost of ownership for aircraft and ground power systems. This will be accomplished by replacing fluid-powered (hydraulics/bleed air) accessories with electrically-powered systems. Representative improvements include increased reliability (8-18%); improved maintainability (9-12%); and reduced vulnerability (12-14%).

(U) **FY 1997 (\$ in Thousands):**

- (U) \$1,076 Designed, fabricated, and tested an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability.
- (U) \$935 - (U) Initiated testing of fault tolerant 270 Vdc power system demonstrating fault tolerance and a 40% reduction in weight. Designed, fabricated, and tested components supporting a demonstrator aircraft electrical distribution system.
- (U) \$590 - (U) Initiated fabrication and testing of advanced motor controller for aircraft demonstrating a 50% improvement in power density. Designed, fabricated, and tested a demonstrator aircraft on-board Integrated Power Unit (IPU). The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.
- (U) Completed preliminary design of aircraft on-board IPU hardware which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.
- (U) \$2,601 Total

Project 3035

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
3 - Advanced Technology Development		0603216F Aerospace Propulsion and Power Technology	3035
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,048	Design, fabricate, and test an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability.		
- (U) \$424	- (U) Test fault tolerant 270 Vdc power system demonstrating fault tolerance and a 40% reduction in weight. Design, fabricate, and test components supporting a demonstrator aircraft electrical distribution system.		
- (U) \$2,000	- (U) Complete fabrication and testing of advanced motor controller for aircraft demonstrating a 50% improvement in power density. Design, fabricate, and test a demonstrator aircraft on-board Integrated Power Unit (IPU). The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.		
- (U) \$3,472	- (U) Complete detailed design of aircraft on-board IPU hardware which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.		
Total			
(U) FY 1999 (\$ in Thousands):			
- (U) \$441	Design, fabricate, and test an electrical distribution system which ensures fault tolerant architecture, improving aircraft reliability and survivability.		
- (U) \$1,000	- (U) Complete testing of fault tolerant 270 Vdc power system demonstrating fault tolerance and a 40% reduction in weight. Develop an aircraft electrical power generation and distribution system for test validation and flight demonstration. The electrical distribution system ensures fault tolerant architecture, improving aircraft reliability and survivability.		
- (U) \$1,958	- (U) Initiate development of an advanced aircraft electrical power generation and distribution system. The advanced electrical power system provides a two- to three-fold improvement of system reliability.		
- (U) \$3,399	Design, fabricate, and test a demonstrator aircraft on-board IPU. The IPU is critical for aircraft engine starting, auxiliary power, and emergency power.		
- (U) \$3,399	- (U) Fabricate components for aircraft on-board IPU which will demonstrate the integration of auxiliary and engine electrical starting power functions providing a two- to three-fold increase in reliability and a two-fold reduction in weight.		
Total			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
3 - Advanced Technology Development	0603216F Aerospace Propulsion and Power Technology	3035																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>2,605</td> <td>3,682</td> <td>3,467</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>2,601</td> <td>3,472</td> <td>3,399</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602203F, Aerospace Propulsion.</li> <li>- (U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	2,605	3,682	3,467	Cost	(U) Current Budget Submit/FY 1999 PB	2,601	3,472	3,399	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	2,605	3,682	3,467	Cost														
(U) Current Budget Submit/FY 1999 PB	2,601	3,472	3,399	Cont														

Project 3035

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603216F Aerospace Propulsion and Power

PROJECT

681B

Technology

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
681B	Advanced Turbine Engine Gas Generator	28,894	28,121	33,526	34,451	35,961	34,797	36,245	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops turbine engine gas generator technology to meet the requirements of current and future aircraft propulsion systems. The objective is to provide the continued evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability aspects can be assessed in a real engine environment. The gas generator, or core, is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine. Experimental core engine testing enhances early, low-risk transition of key engine technologies into engineering development where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, and ships. The Advanced Turbine Engine Gas Generator project supports the Integrated High Performance Turbine Engine Technology (IHPTET) program. IHPTET is a three phase, totally integrated DoD, DARPA, NASA, and industry program focused on doubling turbine engine propulsion capabilities while reducing cost of ownership. The IHPTET program structure provides continuous technology transition for military turbine engine upgrades and derivatives and has the added benefit of enhancing the U.S. turbine engine industry's international competitiveness and demonstrates affordable turbine engine high pressure core components.

## (U) FY 1997 (\$ in Thousands):

- (U) \$23,400 Designed, fabricated, and initiated performance testing of technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) Tested a turbofan/turbojet core engine demonstrating a 60% increase in thrust-to-weight ratio, a 20% reduction in manufacturing cost, and a 20% reduction in maintenance costs.
- (U) \$4,212 Designed, fabricated, and conducted durability testing of technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.
- (U) Conducted a high temperature durability test of turbofan/turbojet core engine demonstrating critical technology potential life characteristics.
- (U) \$1,282 Designed, fabricated, and tested technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.
- (U) Tested a turboprop/turboshaft core engine demonstrating a 30% reduction in fuel consumption and an 80% increase in power-to-weight ratio.
- (U) \$28,894 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603216F Aerospace Propulsion and Power Technology	681B	
(U) FY 1998 (\$ in Thousands):			
- (U) \$25,086	Design, fabricate, and performance test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.		
-	(U) Fabricate hardware (high temperature metal matrix composite compressor rotor, advanced nickel turbine disk) and assemble a core engine for high compressor exit temperature testing (30% reduction in fuel consumption).		
-	(U) Design and fabricate core engine hardware (high stage loading compressor, dual-web turbine disk, air to fuel heat exchanger) in support of core engine testing to provide a 40% reduction in fuel consumption, a 100% increase in thrust-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.		
- (U) \$617	Design, fabricate, and durability test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.		
-	(U) Conduct cyclic durability testing of a turbofan/turbojet core engine demonstrating critical technology potential life characteristics.		
- (U) \$2,418	Design, fabricate, and test technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.		
-	(U) Test a turboprop/turboshaft core engine demonstrating a 28% reduction in fuel consumption and a 102% increase in power-to-weight ratio.		
-	(U) Initiate the design of a turboprop/turboshaft core engine with a 40% reduction in fuel consumption, a 120% increase in power-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.		
- (U) \$28,121	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$21,758	Design, fabricate, and performance test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.		
-	(U) Fabricate hardware for an advanced core engine with a high stage loading compressor, dual web turbine disk, and air to fuel heat exchanger to provide an initial assessment of these critical technologies required to provide a 40% reduction in fuel consumption, a 100% increase in thrust-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.		
- (U) \$7,847	Design, fabricate, and durability test technology demonstration core engines for turbofan/turbojet engines for fighters, attack aircraft, bombers, and large transports.		
-	(U) Conduct high compressor exit temperature testing (30% reduction in fuel consumption) of an advanced core engine with a high temperature metal matrix composite compressor rotor and an advanced nickel turbine disk.		

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Exhibit R-2 (PE 0603216F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>	<b>0603216F Aerospace Propulsion and Power Technology</b>	<b>681B</b>
<p>- (U) \$3,921 Design, fabricate, and test technology demonstration core engines for turboshaft/turboprop and small turbofan engines for trainers, rotorcraft, special operations aircraft, theater transports, and large uninhabited air vehicles.</p> <p>- (U) Test a turboprop/turboshaft core engine demonstrating a 30% reduction in fuel consumption, a 112% increase in power-to-weight ratio, a 20% reduction in manufacturing cost, and a 20% reduction in maintenance cost.</p> <p>- (U) Complete the design of a turboprop/turboshaft core engine with a 40% reduction in fuel consumption, a 120% increase in power-to-weight ratio, a 35% reduction in manufacturing cost, and a 35% reduction in maintenance cost.</p> <p>- (U) \$33,526 Total</p>		

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY		PROJECT																
3 - Advanced Technology Development		681B																
PE NUMBER AND TITLE		0603216F Aerospace Propulsion and Power Technology																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>29,876</td> <td>31,707</td> <td>34,224</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>28,894</td> <td>28,121</td> <td>33,526</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>- (U) PE 0602203F, Aerospace Propulsion.</li> <li>- (U) PE 0603202F, Aircraft Propulsion Subsystem Integration.</li> <li>- (U) PE 0602122N, Aircraft Technology.</li> <li>- (U) PE 0603210N, Aircraft Propulsion.</li> <li>- (U) PE 0603003A, Aviation Advanced Technology.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	29,876	31,707	34,224	Cost	(U) Current Budget Submit/FY 1999 PB	28,894	28,121	33,526	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	29,876	31,707	34,224	Cost														
(U) Current Budget Submit/FY 1999 PB	28,894	28,121	33,526	Cont														



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PE NUMBER: 0603227F

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PE TITLE: Personnel, Training, and Simulation Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE		February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE								
3 - Advanced Technology Development		0603227F Personnel, Training, and Simulation Technology								
PROJECT		2743								
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2743	Advanced Training/Force Management	6,928	5,668	6,636	6,165	7,013	5,667	5,836	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, the three projects in this Program Element (Project 2743, Combat Aircrew Training Technology; Project 2922, Manpower and Force Management; and Project 2949, Advanced Training Technology) have been combined into a single project (Project 2743, Advanced Training/Force Management). The total PE costs shown for FY 1997 reflect this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates Manpower, Personnel, and Training (MPT) technologies that will result in improved warfighter readiness. Develops, demonstrates, and evaluates technologies for distributed mission training including realistic, effective, and affordable synthetic combat environments, technologies for long distance networking to enhance joint-Service training, visual displays for real-time and post-mission debrief, instructional strategies to support warfighter training in a joint synthetic battlespace. Provides a technology testbed for examining warfighter skills, cognitive functions, and behaviors contributing to combat readiness. Develops and demonstrates technologies necessary to provide realistic training for night time warfighting. Develops and demonstrates computer-based intelligent tutoring technology for representative tasks in high technology jobs, and software to enable Air Force training developers to rapidly and affordably build intelligent computer assisted training systems which continually interact with students for effective individualized training. Develops and demonstrates information management technology for the warfighter at the unit level.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603227F Personnel, Training, and Simulation Technology	2743	
(U) FY 1997 (\$ in Thousands):			
- (U) \$2,050	Developed, demonstrated, and evaluated aircrew training devices and associated technology for air warrior training.		
-	(U) Demonstrated a low-cost, high-fidelity, deployable C-130 simulator.		
-	(U) Designed a simulated threat system to encompass a full range of electronic threat environments for air-to-air, air-to-ground, and communication jamming applications.		
-	(U) Integrated mission planning tools with distributed mission training.		
-	(U) Defined High Level Architecture (HLA) requirements for application to fighter level operations.		
-	(U) Demonstrated integrated virtual and constructive environments for distributed mission training.		
-	(U) Defined information requirements for deployable mission support station.		
- (U) \$1,888	Developed and demonstrated Night Vision Goggle (NVG) training and guidelines to meet Air Force requirements.		
-	(U) Developed NVG mishaps lessons learned courseware.		
-	(U) Demonstrated real-time simulation of incompatible lighting effects in NVG imagery.		
-	(U) Developed evaluation techniques for aircraft external lighting for NVG operations.		
-	(U) Developed and evaluated low-cost visual display suitable for NVG simulator-based training.		
-	(U) Developed metrics to assess NVG simulation quality.		
- (U) \$ 968	Developed technologies to structure Air Force and DoD jobs and classify personnel to maximize individual and organizational personnel readiness, job performance, and mission accomplishment.		
-	(U) Developed an inter-Service occupational classification technology for manpower planning.		
-	(U) Conducted independent validation and verification of Manpower, Personnel, and Training Decision Support System.		
- (U) \$ 226	Evaluated a learning sample approach to aircrew selection.		
- (U) \$ 894	Developed and demonstrated software and authoring tools for intelligent tutors.		
-	(U) Continued to develop virtual environment authoring technology.		
- (U) \$ 444	(U) Developed and evaluated advanced intelligent tutors for application to formal technical training programs and on-the-job training. Delivered career field decision support software for personal computer use to Air Force customers.		
-	(U) Completed field assessment of the training impacts decision technology.		
- (U) \$ 458	(U) Made available for transition to operational Air Force training impacts decision technology.		
-	Developed advanced instructional design advisor technology to reduce the cost and time to design and develop interactive courseware.		
- (U) \$6,928	(U) Integrated functional and procedural instructional design guidance into authoring design demonstrations.		
-	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603227F Personnel, Training, and Simulation Technology	2743	
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,401	Develop, demonstrate, and evaluate aircrew training devices and associated technologies for air warrior training.		
-	(U) Evaluate a high resolution microlaser projector for full combat mission training.		
-	(U) Develop a simulated command and control model.		
-	(U) Demonstrate four-aircraft testbed capability for distributed mission training.		
-	(U) Update functional specification for multi-level security networked simulation environment.		
-	(U) Demonstrate mobile, interactive, air and ground threat environment.		
-	(U) Demonstrate preliminary implementation of High Level Architecture (HLA) in four-aircraft testbed environment.		
- (U) \$1,802	Develop and demonstrate Night Vision Goggle (NVG) training guidelines to meet Air Force requirements.		
-	(U) Develop NVG mishaps lessons learned courseware.		
-	(U) Field test distance estimation training module.		
-	(U) Develop specification for NVG gain.		
-	(U) Develop specification for external lighting for NVG operation.		
-	(U) Develop recommendations for enhanced multi-spectral database.		
-	(U) Demonstrate proof-of-concept of enhanced NVG simulation.		
- (U) \$1,201	Develop, demonstrate, and evaluate knowledge representation technologies for human performance enhancement.		
-	(U) Demonstrate generalizable knowledge representation scheme and student modeling module.		
- (U) \$ 264	Initiate migration of knowledge representation technologies for human performance assessment to the JAVA computer language.		
-	Develop advanced instructional design advisor capability to support team-based instructional design.		
- (U) \$5,668	Integrate wide area network capability into advanced instructional design advisor.		
-	Total		

Project 2743

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Exhibit R-2 (PE 0603227F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603227F Personnel, Training, and Simulation Technology	2743	
(U) FY 1999 (\$ in Thousands):			
- (U) \$2,380	Develop and evaluate technologies for Distributed Mission Training (DMT) environments.		
	- (U) Demonstrate mobile, interactive air and ground defense simulation system.		
	- (U) Demonstrate preliminary implementation of High Level Architecture (HLA) in multi-aircraft testbed environment.		
- (U) \$ 789	Develop and evaluate training methodologies to optimize training in DMT environments.		
	- (U) Use eye tracking technology to develop optimized visual scan training to enhance situation awareness in multi-ship combat training.		
	- (U) Implement and evaluate automated performance measures for crew debrief.		
	- (U) Evaluate training effectiveness of advanced combat training in multi-ship simulation scenarios.		
	- (U) Demonstrate and evaluate advanced instructional tools for squadron level electronic classroom.		
- (U) \$2,067	Develop and demonstrate Night Vision Goggle (NVG) training guidelines to meet Air Force requirements.		
	- (U) Develop and evaluate optimized perceptual training guidelines which will help aviators interpret unnatural aspects of NVG and other cockpit displays during night missions.		
	- (U) Evaluate fidelity and training effectiveness of real-time optimized NVG imagery for ground based simulation training.		
	- (U) Evaluate training implications of advanced fused sensor technology.		
	- (U) Provide technical support in areas of acquisition and flight test, lighting compatibility evaluation principles, and mishap investigations		
- (U) \$1,400	Develop advanced weapon system NVG courseware.		
	Develop, demonstrate, and evaluate knowledge representation technologies for human performance enhancement.		
	- (U) Initiate evaluation of knowledge based intelligent computer adaptive instruction authoring system.		
	- (U) Continue migration of knowledge representation technologies for human performance assessment to the JAVA computer language.		
- (U) \$6,636	Total		

Project 2743

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Exhibit R-2 (PE 0603227F)

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603227F Personnel, Training, and Simulation

2743

## Technology

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	7,420	6,147	7,182	Cost
(U) Appropriated Value	7,761	6,147		Cont
(U) Adjustments to Appropriated Value				
a. Congressional/General Reduction	-165	-320		
b. SBIR	-176	-159		
c. Omnibus/Other Above Threshold Reprogrammings	-472			
d. Below Threshold Reprogrammings	-8			
e. Rescissions	-12			
(U) Adjustments to Budget Year Since FY 1998 PB			-546	
(U) Current Budget Submit/FY 1999 PB	6,928	5,668	6,636	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Armstrong Lab Exploratory Development.
- (U) PE 0604227F, Flight Simulator Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE	February 1998			
BUDGET ACTIVITY		PE NUMBER AND TITLE								
3 - Advanced Technology Development		0603231F Crew Systems & Personnel Protection Technology								
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost		22,191	24,881	16,603	17,356	18,267	15,862	16,265	Continuing	Continuing
2830 Crew Workstations, Life Support, and Escape		15,456	14,407	10,181	10,708	11,453	9,232	9,457	Continuing	Continuing
3257 Helmet-Mounted Sensory Technologies		6,735	10,474	6,422	6,648	6,814	6,630	6,808	Continuing	Continuing
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0
<p>Note: Beginning in FY 1998, three projects (Project 2829, Crew-Centered Cockpit Design; Project 2830, Advanced Life Support; and Project 2868, Crew Escape) are combined into a single project (Project 2830, Crew Workstations, Life Support, and Escape). The total project costs for Project 2830 shown in FY 1997 reflect this consolidation.</p>										
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This Advanced Technology Development program develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments. Specific projects within this PE advance and integrate human factors technologies into crew workstation, life support, and protective equipment designs. These technologies encompass the development and demonstration of high-speed escape system flight control and life protection devices for high-speed, adverse attitude flight regimes to include those derived from the Russian ejection seat (U.S. - Russian cooperation). Improves life support technologies principally focused on protecting aircrew from effects of altitude and G-forces in high performance aircraft and adjusting specifications of existing equipment to accommodate the increasing operational envelope and a more diversified population of aircrew members. Improves the ability to quantify crew system automation requirements through data from constructive analysis and real-time distributed simulation. Using models of human perception and knowledge of cognitive function, and performance in high workload environments, technologies will be developed that will incorporate advanced helmet-mounted capability tracker and displays for target detection, identification, sighting, and weapons firing. Improved helmet-mounted night vision device capability and laser eye protection capability will be incorporated to address the operational limitations of fighting at night and in hazardous laser environments. Additionally, advanced on-board oxygen generation systems will be developed to alleviate the logistics burden of current liquid oxygen systems that require ground-based oxygen generation plants. Note: Congress added \$9 million in FY 1998 for crew escape/ejection seats (\$5 million), helmet-mounted display (\$3 million), and laser-eye protection (\$1 million), which explains the perceived decrease in FYs 1999 and out.</p>										

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**3 - Advanced Technology Development**

**0603231F Crew Systems & Personnel Protection Technology**

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	21,442	17,204	17,966	
(U) Appropriated Value	22,969	26,204		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-489	-959		
b. SBIR	-538	-364		
c. Omnibus/Other Above Threshold Reprogrammings	-1,215			
d. Below Threshold Reprogrammings	1,500			
e. Rescissions	-36			
(U) Adjustments to Budget Year Since FY1998 PB			-1,363	
(U) Current Budget Submit/FY 1999 PB	22,191	24,881	16,603	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program. Below Threshold Reprogramming was for Cockpit Mapping efforts.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603231F Crew Systems &amp; Personnel Protection

PROJECT

2830

Technology

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2830 Crew Workstations, Life Support, and Escape	15,456	14,407	10,181	10,708	11,453	9,232	9,457	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project improves combat performance, develops rigorous, traceable human-centered design methodologies; protects aircrews from physiological stresses such as high altitude, high G-forces, high temperature, and aerodynamic forces; and reduces aircrew fatalities and major injuries in emergency ejections at high-speed and at low altitude, adverse attitude flight conditions, while improving supportability and accommodating the full range of the pilot population.

(U) FY 1997 (\$ in Thousands):

- (U) \$ 792 Developed and demonstrated technologies for improved protective equipment for aircrew and support personnel.
- (U) Continued development and demonstration of advanced aircrew oxygen mask technology for high-G and high-altitude operations.
- (U) Demonstrated personal protective equipment technology to provide improved protection in hostile environments for female aviators.
- (U) Developed and transitioned to the Air Force Information Warfare Center (AFIWC) the Laser Threat Analysis System (LTAS) version 2.0 for eye damage and Night Vision Goggles (NVG) Maverick vulnerability.
- (U) Demonstrated compatibility of single-line, visible wavelength laser-eye protection (LEP) with heads up display and aircraft avionics displays.
- (U) \$ 1,340 Developed and demonstrated life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.
- (U) Continued development of advanced hybrid oxygen technologies for aeromedical operations.
- (U) Completed laboratory demonstration of personal environmental cooling technology for aircrews.
- (U) \$ 1,309 Concluded verification testing and beta testing of human-centered software tools for design and modification of operator stations.
- (U) Transitioned human-centered evaluation technology to more than fifty sites in DoD and industry.
- (U) Concluded field demonstration of crew-centered design and evaluation technology, correlating human performance with mission/system performance in the cockpit.
- (U) \$ 438 Conducted human-centered design studies to support advanced distributed simulation.
- (U) Assessed human performance models to make valid predictions for aircraft ground attack.
- (U) Began definition program for a simulation-based combat automation requirements testbed.
- (U) Developed analytical techniques to link human measures of performance to system level measures of effectiveness.
- (U) \$ 5,453 Developed a demonstrator to evaluate life-saving capabilities of an escape system including technologies derived from the Russian K-36 ejection seat (U.S. - Russian cooperation).
- (U) Established ejection seat performance baseline.
- (U) Conducted preliminary design studies of the demonstration system.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603231F Crew Systems & Personnel Protection Technology	February 1998	2830
	<ul style="list-style-type: none"><li>- (U) Designed demonstration system for accommodation of the expanded aircrew population.</li><li>- (U) Fabricated and delivered two prototype demonstrator ejection seats.</li></ul>		
- (U) \$ 2,582	Demonstrated controlled ejection seat flight from high-speed and from adverse ejection attitudes.		
	<ul style="list-style-type: none"><li>- (U) Completed high-speed/adverse-attitude ejection seat testing.</li><li>- (U) Analyzed data and documented escape system technology demonstration program results.</li></ul>		
- (U) \$ 3,542	Developed technologies to address small occupant requirements for current operational ejection seats.		
	<ul style="list-style-type: none"><li>- (U) Tested existing Air Force/Navy/Marine Corps front-line trainer and tactical aircraft ejection seats with lightweight crew members to verify their predicted performance and identify problems.</li><li>- (U) Designed and tested technology to upgrade existing ejection seats to accommodate small occupants.</li><li>- (U) Demonstrated accommodation of lower weight female crew members.</li></ul>		
- (U) \$15,456	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 276	Continue to develop and demonstrate technologies for improved protective equipment for aircrew and support personnel.		
- (U) \$ 1,472	<ul style="list-style-type: none"><li>- (U) Complete development and demonstrate advanced oxygen mask technology for high-G and high-altitude operations.</li></ul>		
	Develop and demonstrate life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burdens.		
- (U) \$ 1,514	<ul style="list-style-type: none"><li>- (U) Demonstrate advanced hybrid oxygen technologies for aeromedical operations.</li><li>- (U) Initiate development of technologies, allowing replacement of current liquid oxygen systems for transport aircrews.</li></ul>		
	Develop and demonstrate human-centered design and evaluation of technologies to support advanced distributed simulation.		
- (U) \$ 1,514	<ul style="list-style-type: none"><li>- (U) Complete functional analysis of crew tasks and information flow for distributed simulation of defense suppression mission.</li><li>- (U) Determine feasibility of adding crew behavioral model to engagement-level constructive simulation.</li></ul>		
- (U) \$ 4,304	<ul style="list-style-type: none"><li>- (U) Continue planning for a simulation-based combat automation requirements testbed.</li></ul>		
	Demonstrate advanced escape technologies incorporating Russian technology.		
- (U) \$ 4,304	<ul style="list-style-type: none"><li>- (U) Fabricate demonstration ejection seats for adverse attitude/high-speed ejection seat tests.</li><li>- (U) Conduct ejection seat tests to demonstrate seat performance and life saving capacity.</li><li>- (U) Analyze data and document lightweight ejection seat demonstration program results.</li></ul>		
- (U) \$ 4,574	Reduce the technical risks associated with adapting the lightweight Russian ejection seat technologies to U.S. aircraft.		
	<ul style="list-style-type: none"><li>- (U) Assess ejection seat interfaces with aircraft cockpits.</li><li>- (U) Verify compatibility with current Air Force/Navy personal equipment.</li><li>- (U) Explore low-cost ballistic cartridges and propulsion systems as a joint effort with the U.S. Navy.</li><li>- (U) Analyze life cycle and logistics support concept improvements.</li></ul>		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603231F Crew Systems & Personnel Protection Technology	February 1998	2830
	<ul style="list-style-type: none"> <li>- (U) Define manufacturing concepts and technologies for production in the U.S.</li> <li>- (U) Demonstrate technologies to address small occupant requirements for current ejection seats.</li> <li>- (U) Demonstrate controlled propulsion technology as an upgrade to existing ejection seats to safely eject the expanded aircrew population.</li> <li>- (U) Evaluate alternative technology enhancements to accommodate the expanded aircrew population in current tactical aircraft.</li> </ul>		
	Total		
	(U) \$2,267		
	(U) \$14,407		
(U) FY 1999 (\$ in Thousands):			
	- (U) \$ 1,847	Develop a simulation testbed for evaluating weapon systems automation requirements in terms relating crew performance to mission outcome.	
		- (U) Define a process to quantify crew performance requirements and to base automation design on crew performance data.	
		- (U) Establish the testbed concept of operation for use during system development and show that crew performance data extracted from combat simulation can verify design decisions.	
		- (U) Begin developing a human performance model to inter-relate crew task performance with combat mission outcome via engagement simulation.	
	- (U) \$ 2,500	Integrate and demonstrate subsystems to protect the aircrew member during emergency ejections.	
		- (U) Build integrated design of a passive head/neck protection subsystem onto existing ejection seat high-speed escape.	
		- (U) Test design of command inertial haulback reel for restraint during escape and during in-flight maneuvering.	
		- (U) Develop an ejection seat insert which combines proven technologies for enhanced comfort, improved impact, and vibration response and is adaptable to current Air Force/Navy ejection seats.	
	- (U) \$ 3,200	Demonstrate improved aircraft emergency escape in existing trainer aircraft.	
		- (U) Demonstrate the feasibility of adding escape system capability to the T-3 aircraft currently possessing bail-out only capability.	
	- (U) \$ 634	- (U) Investigate improved ejection seat in T-38 trainer aircraft for full aircrew accommodation.	
		Develop ejection seat evaluation capabilities for high-speed escape.	
		- (U) Develop and demonstrate instrumentation suites for measurement of aerodynamic and inertial loads acting on a crewmember during emergency aircraft ejection to develop crewmember protection and ejection seat rocket motor design criteria.	
	- (U) \$ 2,000	Continue to develop and demonstrate life support technologies for integration into aircraft to improve aircrew safety and reduce logistical burden.	
		- (U) Continue development of technologies to eliminate limits and logistics problems of existing oxygen systems on heavy aircraft.	
	- (U) \$10,181	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
3 - Advanced Technology Development		0603231F Crew Systems & Personnel Protection Technology	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		14,696	9,967
(U) Current Budget Submit/FY 1999 PB		15,456	14,407
			FY 1999
			12,129
			10,181
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0602202F, Armstrong Lab Exploratory Development.			
- (U) PE 0604703F, Aeromedical/Casualty Care Systems Development.			
- (U) PE 0604706F, Life Support Systems.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998							
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT								
3 - Advanced Technology Development	0603231F Crew Systems & Personnel Protection Technology	3257								
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3257	Helmet-Mounted Sensory Technologies	6,735	10,474	6,422	6,648	6,814	6,630	6,808	Continuing	Continuing
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This project develops and demonstrates advanced helmet-mounted subsystem technologies to improve mission effectiveness and pilot situational awareness during day and night missions in all-weather conditions. Through the development of advanced helmet-mounted tracker and display technologies (HMT/D), pilots will be able to detect, identify, target, and launch weapons faster and more accurately. This project also develops technology for improved night vision goggles (NVG) to enhance combat capabilities at night.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$ 5,069 Developed and demonstrated Helmet Vehicle Interface (HVI) and subsystems technologies for HMT/D.</li> <li>- (U) Developed design for new HMT/D with color symbology display.</li> <li>- (U) Demonstrated advanced HMT/D on two operational fighters and transitioned to the Air Force/Navy Joint Helmet-Mounted Cueing System (JHMCS).</li> <li>- (U) Evaluated advanced HVI designs.</li> <li>- (U) Continued evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.</li> </ul> <p>- (U) \$ 1,431 Developed and demonstrated advanced night vision technologies for DoD aircrew requirements.</p> <ul style="list-style-type: none"> <li>- (U) Evaluated improved NVG technologies.</li> <li>- (U) Developed new image intensifier tube technology for NVG.</li> <li>- (U) Demonstrated concept for panoramic NVG with expanded field-of-view.</li> </ul> <p>- (U) \$ 235 Evaluated windscreens and canopy transparency distortions.</p> <ul style="list-style-type: none"> <li>- (U) Measured F-15 and F-16 transparencies for JHMCS program office.</li> <li>- (U) Developed initial compensation polynomial to correct transparency distortions for HMT/Ds.</li> </ul> <p>- (U) \$ 6,735 Total</p> <p>(U) <b>FY 1998 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$ 3,321 Continue to develop and demonstrate HMT/D and subsystem technologies.</li> <li>- (U) Demonstrate HMT/D with color symbology display in simulator.</li> <li>- (U) Assess component improvements for HMT/Ds for fighters.</li> <li>- (U) Evaluate eye tracker technologies for use in flight-qualified oculometer.</li> <li>- (U) Continue evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.</li> </ul>										

Project 3257

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Exhibit R-2 (PE 0603231F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603231F Crew Systems & Personnel Protection Technology	February 1998	3257
- (U) \$ 1,543	Develop and demonstrate advanced laser eye protection (LEP) technologies and laser susceptibility models.		
- (U) \$ 2,610	- (U) Deliver Laser Threat Analysis System (LTAS) version 2.0 incorporating air-to-ground threats in Dynamic three-dimensional Fly-by-Animation.		
- (U) \$ 3,000	- (U) Initiate early operational assessment of single-line, visible wavelength LEP in various aircraft.		
- (U) \$ 10,474	- (U) Complete flight assessment of dielectric stack technology in F-15E and F-117 aircraft.		
	- (U) Expand flight test of dielectric stack technology to include C-17 and AC-130 aircraft.		
	- (U) Develop and evaluate Airborne Laser (ABL) protection technologies.		
	Continue to develop and demonstrate advanced night vision technologies for DoD aircrew requirements.		
	- (U) Demonstrate panoramic night vision goggles (NVG) with dynamic symbology overlay.		
	- (U) Assess improved image intensifier tube technology for NVGs.		
	Develop miniature flat-panel image source for helmet-mounted tracker and displays (HMT/Ds).		
	- (U) Demonstrate high resolution monochrome image source at high luminance levels.		
	- (U) Assess potential of miniature flat-panel image source for helmet-mounted tracker and display technologies (HMT/D) applications.		
	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$ 2,877	Continue to develop and demonstrate HMT/D and subsystem technologies.		
	- (U) Demonstrate HMT/D with color symbology display in aircraft.		
	- (U) Assess component improvements for HMT/Ds for fighters.		
	- (U) Continue to evaluate eye tracker technologies for use in flight-qualified occulometer.		
- (U) \$ 1,283	- (U) Continue evaluation of anthropometric technology issues for fit of HMT/D on full pilot population.		
	Develop and demonstrate advanced laser eye protection (LEP) technologies and susceptibility models.		
	- (U) Initial phase of integrating Laser Threat Analysis System (LTAS) into the Distributed Interactive Simulation (DIS) as the Directed Energy Warfare (DEW) server for laser and broadband optical threats.		
	- (U) Develop and validate reflectivity analysis tool to evaluate the hazards of high energy laser systems.		
- (U) \$ 2,262	- (U) Continue flight tests of dielectric stack technology to include C-17 and AC-130 aircraft.		
	Continue to develop and demonstrate advanced night vision technologies for DoD aircrew requirements.		
- (U) \$ 6,422	- (U) Demonstrate Panoramic Night Vision Goggles (PNVG) with imagery overlay.		
	Total		

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603231F Crew Systems &amp; Personnel Protection

3257

Technology

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Current Budget Submit/FY 1999 PB	6,746	7,237	5,837	Cost
	6,735	10,474	6,422	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to increased emphasis on laser eye protection (LEP) technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0602202F, Armstrong Lab Exploratory Development.
- (U) PE 0603238F, Global Surveillance and Communications.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604201F, Common Avionics Planning/Development.
- (U) PE 0207130F, F-15 Squadrons.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 3257

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Exhibit R-2 (PE 0603231F)



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PE NUMBER: 0603245F

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PE TITLE: Flight Vehicle Technology Integration

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE		February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE					PROJECT			
3 - Advanced Technology Development		0603245F Flight Vehicle Technology Integration					2568			
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2568	Flight Vehicle Technology Integration	5,948	6,062	7,674	8,807	10,884	10,133	10,674	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program integrates and demonstrates advanced flight vehicle technologies that will improve the performance and supportability of existing and future aircraft. System level integration brings together the air vehicle technologies along with avionics, propulsion, and weapon systems to flight demonstrate them in a near-realistic operational environment. Integration and flight test demonstrations reduce the risk and time required to transition technologies into operational aircraft. This program provides proven flight vehicle technologies for all-weather, day or night operations, and technologies for improved affordability. Note: In FYs 1999 and out, additional emphasis has been placed on analyzing the flight control forces and moments of the Variable Stability In-flight Simulation Test Aircraft (VISTA). FY 1997 and FY 1998 Congressional adds for VISTA were executed in PE 0604237.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,086 Developed and demonstrated advanced aeromechanics and flight control technologies for evaluation of increased combat effectiveness.
- (U) \$3,739 (U) Flight-tested high-authority propulsion flight control systems for demonstration of increased range, elimination of loss of control, and improved supersonic maneuvering up to Mach 2.0.
- (U) \$1,123 Developed and demonstrated advanced subsystem technologies and technology integration for evaluation of increased supportability and combat effectiveness.
- (U) \$5,948 (U) Completed aircraft modification for long-life, all-envelope, integrated flight and propulsion control subsystem for VISTA to evaluate impact of advanced maneuvering capabilities for air-to-air and air-to-ground combat.
- (U) \$1,123 (U) Completed installation and integration flight testing of programmable head-up display and helmet-mounted display capabilities.
- (U) \$5,948 Performed static and sub-scale testing of three next-generation nozzle concepts to determine fluidic control effectiveness in improving stealthiness and performance while simplifying design.
- (U) \$5,948 Total

Project 2568

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Exhibit R-2 (PE 0603245F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603245F Flight Vehicle Technology Integration

2568

## (U) FY 1998 (\$ in Thousands):

- (U) \$2,364 Develop, integrate, and demonstrate advanced aeromechanics, propulsion, and flight control technologies for increasing combat effectiveness.
- (U) Modified the high-authority propulsion flight control systems to remove vertical tail surface area for demonstration of increased range, elimination of loss of control accidents, and improved supersonic maneuvering.
- (U) Completed detailed design and initiate fabrication of selected critical components required for next generation simplified nozzle and airframe structural integration.
- (U) \$555 Initiate development of control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aircraft.
- (U) \$3,143 Develop, integrate, and demonstrate advanced subsystem technologies and technology integration for evaluation of significant improvement in air-to-air combat effectiveness.
- (U) Completed detailed design and initiate fabrication of aircraft structural component for demonstration, with significant increase in survivability of existing military aircraft.
- (U) Developed methodology to analyze the effect of unique control forces and moments on the structural integrity of the Variable Stability In-flight Simulation Test Aircraft (VISTA).
- (U) \$6,062 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$2,543 Develop, integrate, and demonstrate advanced aeromechanics, propulsion, and flight control technologies for increasing combat effectiveness.
- (U) \$964 Complete fabrication of selected next-generation flow control exhaust nozzle and airframe structural critical components. Complete development and flight-test control strategies to extend range, ensure safe operation, and allow precision close operations of mixed manned and unmanned aircraft.
- (U) \$4,167 Develop, integrate, and demonstrate advanced subsystem technologies and technology integration for evaluation of significant improvement in air-to-air combat effectiveness.
- (U) Complete development of methodology to analyze the effect of unique control forces and moments on VISTA's structural integrity.
- (U) Develop flight-test units of electric actuator stabilizers for reducing weight while increasing affordability of control actuators.
- (U) Develop concept for demonstration of integrated aerodynamic, structural, subsystem, flight control, propulsion, materials, and manufacturing technologies as they focus against the UCAV mission.
- (U) \$7,674 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603245F Flight Vehicle Technology Integration

2568

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	6,132	7,795	9,828	Cost
(U) Appropriated Value	6,423	6,423		Cont
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-135	-210		
b. SBIR	-156	-151		
c. Omnibus/Other Above Threshold Reprogrammings	-24			
d. Below Threshold Reprogrammings	-150			Cont
e. Rescissions	-10			
(U) Adjustments to Budget Year Since FY 1998 PB			-2,154	
(U) Current Budget Submit/FY 1999 PB	5,948	6,062	7,674	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0603106F, Logistics Systems Technology.
- (U) PE 0603205F, Flight Vehicle Technology.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0604237F, Variable Stability In-Flight Simulation Test Aircraft.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603253F

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PE TITLE: Advanced Avionics Integration

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603253F Advanced Avionics Integration									
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		14,107	12,012	10,536	8,747	10,796	10,660	10,992	Continuing	Continuing	
2735 Avionics Integration Technology		6,095	5,783	6,016	5,217	5,510	5,437	5,620	Continuing	Continuing	
3833 Integrated Avionics for Aging Aircraft		3,176	2,387	0	0	0	0	0	Continuing	Continuing	
666A Reference and Information Transmission Technology		4,836	3,842	4,520	3,530	5,286	5,223	5,372	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

Note: In FYs 1999 and out, Project 3833 transferred into Project 2735.

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops and demonstrates aircraft communications, navigation, identification, and cockpit display integration technologies and techniques for improved aircraft performance, reduced pilot workload, and reduced avionics support costs. This program develops and improves: advanced solid state inertial guidance units and Global Positioning System receivers; technologies for low probability of detection communications between aircraft to improve aircrew situation awareness; highly reliable and maintainable avionics architectures and advanced processors; integration techniques to reduce aircraft electronic emissions to improve aircraft hostile airspace penetration capability; and affordable avionics technologies to extend the life of aging aircraft.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		February 1998
3 - Advanced Technology Development		0603253F Advanced Avionics Integration
PE NUMBER AND TITLE		
(U) B. <u>Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	14,809	12,716
(U) Adjustments to Appropriated Value	15,488	12,716
a. Congressional/General Reductions	-328	-422
b. SBIR	-351	-282
c. Omnibus/Other Above Threshold Reprogrammings	-675	
d. Below Threshold Reprogrammings	-3	
e. Rescissions	-24	
(U) Adjustments to Budget Year Since FY 1998 PB	14,107	12,012
(U) Current Budget Submit/FY 1999 PB		10,536
		-3,682
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.		
(U) D. <u>Schedule Profile:</u> Not Applicable.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603253F Advanced Avionics Integration

PROJECT

2735

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
2735	Avionics Integration Technology	6,095	5,783	6,016	5,217	5,510	5,437	5,620	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates technologies that provide for robust implementation and exploitation of offensive and defensive sensors; reduced avionics support costs, weight, and volume; and improved reliability. These advanced technologies provide the avionics integration capability that enables improved cockpit systems management, information display, and weapons targeting and tracking and includes integrated avionics architectures, information integration involving on-board and off-board sensors, and sensor management technologies.

(U) FY 1997 (\$ in Thousands):

- (U) \$3,225 Develop advanced modular, sharable radio frequency (RF) sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity allows for retrofits that reduce avionics support costs.
- (U) \$972 Fabricated integrated sensor system module types and unit test the embedded application and control software.
- (U) \$1,898 Develop advanced sensor integration technologies and algorithms to provide the capability to augment the performance of individual sensors which will enable improved fault tolerance and situation awareness.
- (U) \$6,095 Developed and demonstrated affordable, improved anti-jam filter/adaptive aircraft antenna electronics.
- (U) \$6,095 Develop integrated avionics architecture components which leverage prior technology demonstration developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability features.
- (U) \$6,095 Developed high performance, three-dimensional terrain/threat avoidance display generation technology for the low-level avionics mission environment.
- (U) \$6,095 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$3,941 Develop and demonstrate advanced modular, sharable RF sensor processing technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Modularity will allow for retrofits that reduce avionics support costs.
- (U) \$3,941 Integrate components and perform laboratory demonstration of an integrated sensor system which simultaneously performs radar, electronics warfare, communication, navigation, and identification functions.

Project 2735

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603253F Advanced Avionics Integration</b>	<b>2735</b>	
- (U) \$1,228	Develop integrated avionics architecture components which leverage prior technology developments and incorporate additional user requirements for multi-platform commonality, open system architecture compliance, standard high-level software language, affordability, and expandability.		
- (U) \$614	<ul style="list-style-type: none"> <li>- (U) Flight demonstrate a low-level covert penetration capability using common/open system processing hardware and a portable real-time Ada operating system in a simulated threat environment; analyze cost/performance benefits of this capability for special operations aircraft mission rehearsals.</li> <li>- (U) Demonstrate improved threat location using off-board intelligence data integrated with on-board sensor information to improve low-level covert penetration capability for special operations aircraft.</li> </ul>		
- (U) \$5,783	<ul style="list-style-type: none"> <li>- (U) Develop preliminary architectural framework and assess leveraging opportunities in commercial developments.</li> <li>- (U) Total</li> </ul>		
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,816	Develop and demonstrate advanced modular, sharable RF sensor technologies to provide for avionics cost and weight savings, improved reliability, and increased sensor data fusion opportunities. Highly reliable, modular building blocks will enable multi-mission use with reduce combat support assets.		
- (U) \$1,000	<ul style="list-style-type: none"> <li>- (U) Perform integration and application specific demonstrations to ease transition of integrated sensor system technology to currently fielded as well as future systems.</li> <li>- (U) Develop RF adaptive processing techniques to support the mitigation of clutter and jamming and enhance advanced target detection and track from long-range standoff airborne, space-based, and reconnaissance platforms.</li> </ul>		
	Develop technologies that allow the collection and integration of sensor data from various sources in a collaborative engineering environment in order to reduce risks and costs of advanced technology demonstration and to enable faster transition of affordable technology to meet warfighter needs.		
	<ul style="list-style-type: none"> <li>- (U) Develop a collaborative engineering capability which links together non-colocated Air Force resources to provide a comprehensive avionics virtual technology development environment.</li> <li>- (U) Evaluate sensor data in a collaborative engineering environment to determine methods of shortening the timeline for dissemination of information to warfighters.</li> </ul>		

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February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603253F Advanced Avionics Integration

2735

- (U) \$1,200 Develop and demonstrate technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment and, thereby, provide a cost-effective incremental upgrade capability. (In FY 1999, this work transferred from Project 3833, Integrated Avionics for Aging Aircraft.)

- (U) Perform optimization testing of hardware/software technology necessary for simultaneous execution of existing 16-bit avionics software with new 32-bit application software to reduce the life cycle cost of upgrading and maintaining existing weapon systems.

- (U) Develop preliminary architectural framework and assess leveraging opportunities in commercial developments.

Total

- (U) \$6,016

Project 2735

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>		<b>0603253F Advanced Avionics Integration</b>	<b>2735</b>

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	6,682	6,125	6,062	Cost
(U) Current Budget Submit/FY 1999 PB	6,095	5,783	6,016	Cont

(U) Change Summary Explanation:  
 Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.  
 Schedule: Not Applicable.  
 Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:  
 - (U) PE 0603204F, Aerospace Avionics.  
 - (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.  
 - (U) PE 0603270F, Electronic Warfare Technology.  
 - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603253F Advanced Avionics Integration

PROJECT

3833

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3833 Integrated Avionics for Aging Aircraft	3,176	2,387	0	0	0	0	0	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates affordable avionics technology to extend the useful life of Air Force aging aircraft and provide the flexibility and supportability needed to support worldwide operations with reduced force structure. This project focuses on technologies to support transition of modular avionics, commercially available products, and commercial open system standards for cost-effective retrofit of user-required upgrades to existing avionics systems. In FY 1999 and out, this Project transfers to Project 2735.

## (U) FY 1997 (\$ in Thousands):

- (U) \$2,384 Develop and demonstrate programmable integrated communications, navigation, and identification hardware/software modules for currently fielded aircraft applications to provide fleet wide commonality, attendant economies of scale, and increased platform availability.
- (U) \$792 Developed and evaluated technology required to maintain data security and integrate modular communications, navigation, and identification components with existing platform-specific interfaces, hardware, software, and backplanes.
- (U) \$792 Develop hardware and software technologies to support re-use of existing avionics software with newly developed Ada software in a common, real-time, embedded core avionics environment and to provide a cost-effective incremental upgrade capability.
- (U) \$3,176 Developed hardware/software technology necessary for simultaneous execution of existing 16-bit avionics software written in many languages with new 32-bit Ada application and control software to reduce the life cycle cost of upgrading and adding software to existing weapon systems.
- (U) \$3,176 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$404 Develop and demonstrate programmable integrated communications, navigation, and identification hardware/software modules for currently fielded aircraft applications to provide fleet wide commonality, attendant economies of scale, and increased platform availability.
- (U) \$1,377 Demonstrate and transition the technology required to integrate modular communications, navigation, and identification components into existing platforms while maintaining data security.
- (U) \$1,377 Develop and demonstrate technologies to support maximum use of existing avionics software in concert with newly developed software in a real-time avionics environment and, thereby, provide a cost-effective incremental upgrade capability. (In FY 1999, these efforts will transfer to Project 2735, Avionics Integration Technology.)
- (U) Continue development of technology necessary for simultaneous execution of existing 16-bit avionics software written in many languages with new 32-bit Ada application software to reduce the life cycle cost of upgrading and maintaining existing weapon systems.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603253F Advanced Avionics Integration	3833	
- (U) \$606 Develop avionics integration technologies to enable commercial-off-the-shelf components to function reliably in a combat aircraft environment for cost-effective modernization of aging avionics.			
- (U) Determine feasibility of inserting commercial products into an avionics open system architecture.			
- (U) Define candidate open system interfaces to enable competitive development for architectural components.			
- (U) Establish a collaborative engineering capability which links together non-co-located Air Force resources to provide a comprehensive virtual environment for avionics development, eliminating the need for expensive and duplicative hardware and facilities.			
- (U) \$2,387 Total			
(U) <u>FY 1999</u> : Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603253F Advanced Avionics Integration

3833

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)

(U) Current Budget Submit/FY 1999 PB

FY 1997	3,268
	3,176

FY 1998	2,526
	2,387

FY 1999	3,227
	0

Total	
Cost	
Cont	
Cont	

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary (\$ in Thousands):(U) Related Activities:

- (U) PE 0602204F, Aerospace Avionics.

- (U) PE 0602301E, Intelligence System Program.

- (U) PE 0602232N, Navy Command, Control, and Communications (C3) Technology.

- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.

- (U) PE 0604201F, Common Avionics.

- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603253F Advanced Avionics Integration

PROJECT

666A

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
666A Reference and Information Transmission Technology	4,836	3,842	4,520	3,530	5,286	5,223	5,372	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** Develops and demonstrates advanced, high-speed reference and information transmission technologies and techniques to improve overall aircrew situation awareness. These technologies will also reduce the electromagnetic signatures of navigation and communications systems, increasing aircraft survivability. The focus is on incorporating jam-resistant, low probability of detection transceivers, inertial components, navigation systems technology and techniques into air vehicles and on developing techniques for exploiting the capabilities of the Global Positioning System (GPS) to provide highly accurate reference information. Technologies demonstrated under this project are needed for real-time information in the cockpit, stealth operations, precision targeting and strike, timely bomb damage assessment, force multiplication through multi-platform shared resources, and affordable/supportable weapon systems.

## (U) FY 1997 (\$ in Thousands):

- (U) \$925 Develop advanced inertial reference technology and architectures to improve robustness of reference functions and accuracy of weapon/sensor boresights.
- (U) Integrated techniques and planned flight experiments for dynamic airframe flexure compensation and navigation fault detection/isolation to meet precision targeting and weapon delivery requirements.
- (U) \$1,069 Develop enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
- (U) Completed ground experiments and initiate flight experiments of GPS-based techniques to rapidly locate and then counter enemy emitters for an enhanced, low-cost suppression of enemy air defenses capability for tactical fighters.
- (U) \$2,842 Develop multi-user, medium to high capacity, jam-resistant airborne network to provide for low probability of detection exchange of time-critical threat, sensor, and cooperative operations information between aircraft.
- (U) Completed fabrication and demonstration of technology for high-speed, high-bandwidth data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting and strike.
- (U) \$4,836 Total

Project 666A

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Exhibit R-2 (PE 0603253F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603253F Advanced Avionics Integration

666A

## (U) FY 1998 (\$ in Thousands):

- (U) \$2,435 Develop enhancements to Global Positioning System (GPS) user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
- (U) Complete flight experiments of GPS-based techniques to rapidly locate and then counter enemy emitters for an enhanced, low-cost suppression of enemy air defenses capability for tactical fighters.
- (U) Develop optimum anti-jam techniques to fully exploit all-digital GPS user equipment architectures.
- (U) Develop techniques for more accurate precision attack using anti-jam, all-digital GPS user equipment and improved GPS signals.
- (U) \$1,407 Develop multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets.
- (U) Complete brassboard design for a low-cost, real-time adaptive, jam-resistant voice and data transfer suite.
- (U) Complete ground-testing of technology for high-speed, high-bandwidth data transfer capability for secondary dissemination of reconnaissance/intelligence data and imagery to support real-time precision targeting.
- (U) \$3,842 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$2,600 Develop enhancements to GPS user equipment and system integration techniques to maximize position accuracy and jam resistance and exploit the benefits of GPS to improve offensive and defensive combat capabilities at reduced costs.
- (U) Continue to develop anti-jam techniques to fully exploit all-digital GPS user equipment architectures.
- (U) Continue to develop techniques to provide higher accuracy for precision attack using anti-jam, all-digital GPS user equipment and improved GPS signals.
- (U) \$1,920 Develop multi-user, medium to high capacity, jam-resistant airborne network technology to provide for low probability of detection exchange of time-critical threat, sensor, and other information between aircraft and cooperative assets.
- (U) Develop a common, affordable, open system architecture for unmanned aerial vehicles, using commercial standards and interfaces, to reduce avionics costs and improve supportability.
- (U) Develop dual-use brassboard featuring space-based communication and positioning for use by both tactical fighters and business aircraft to meet new federal and international air traffic control standards.
- (U) \$4,520 Total

Project 666A

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Exhibit R-2 (PE 0603253F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603253F Advanced Avionics Integration	666A	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	4,859	4,065	4,929
	4,836	3,842	4,520
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0602204F, Aerospace Avionics.			
- (U) PE 0602782A, Command, Control, and Communications (C3) Technology.			
- (U) PE 0602232N, Navy C3 Technology.			
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.			
- (U) PE 0603270F, Electronic Warfare Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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PE NUMBER: 0603270F

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PE TITLE: Electronic Combat (EC) Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603270F Electronic Combat (EC) Technology									
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		26,133	32,540	25,553	26,533	27,486	27,721	28,415	Continuing	Continuing	
2432 Defensive System Fusion Technology		7,536	5,800	7,171	6,988	6,398	7,728	8,328	Continuing	Continuing	
431G Radio Frequency (RF) Warning and Countermeasures		5,547	12,931	9,215	8,656	7,785	8,874	8,968	Continuing	Continuing	
691X Electro-Optical/Infrared (EO/IR) Warning and Countermeasures		13,050	13,809	9,167	10,889	13,303	11,119	11,119	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

Note: In FYs 1998 and out, several projects in this PE have been combined and/or reorganized. Project 2754, Suppression of Enemy Air Defenses, and the former Project 2432, Defensive System Fusion, have been consolidated within Project 2432, Defensive System Fusion Technology. The radio frequency countermeasures efforts from the former Project 691X, On-board Countermeasures, have moved into Project 431G, Radio Frequency Warning and Countermeasures. Project 2222, Expendable Countermeasures, and the infrared missile warning efforts from the former Project 431G, Threat Alert, have been combined within Project 691X, Electro-Optical/Infrared (EO/IR) Warning and Countermeasures. In addition, precision location and identification efforts (conducted until FY 1997 in the former Project 2432, Defensive System Fusion) are now reported as part of Project 431G, Radio Frequency Warning and Countermeasures. For clarity, FY 1997 portions of this exhibit have used the new project structure.

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program expands the EC technology base by proving design concepts and demonstrating technologies to support critical Air Force EC requirements. The projects are categorized by the development of components, subsystems, and technologies that have potential application to satisfy combat, special operations, and airlift EC requirements and to reduce acquisition and life cycle costs of EC systems. The program develops and demonstrates: radio frequency; infrared; electro-optic; and command, control, and communications countermeasure technologies. Technology demonstrations include flyable brassboards against validated threat simulators. In addition, the program develops and demonstrates technologies and concepts for signature reduction, advanced electronic warfare transmitters, receivers, and power management. This program ensures a strong EC technology base to provide demonstrated counters to current and future threat capabilities. Note: In FY 1998, Congress added \$3.75M for Closed-Loop Infrared Countermeasures technology and \$5.0 M for Precision Location and Identification technologies.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	
3 - Advanced Technology Development		0603270F Electronic Combat (EC) Technology	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	26,414	25,621	26,765
(U) Adjustments to Appropriated Value	27,602	34,371	
a. Congressional/General Reductions	-577	-1,125	
b. SBIR	-611	-706	
c. Omnibus/Other Above Threshold Reprogrammings	-1,063		
d. Below Threshold Reprogrammings	782		
E. Rescissions			
(U) Adjustments to Budget Year Since FY1998 PB			-1,212
(U) Current Budget Submit/FY 1999 PB	26,133	32,540	25,553
			Total
			Cost
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program. Below threshold reprogramming was for advanced decoy development.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u> Not Applicable.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998					
BUDGET ACTIVITY		PROJECT							
3 - Advanced Technology Development		2432							
PE NUMBER AND TITLE		0603270F Electronic Combat (EC) Technology							
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2432 Defensive System Fusion Technology	7,536	5,800	7,171	6,988	6,398	7,728	8,328	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops and demonstrates techniques and technologies for sensor and system fusion and integration. It also develops the advanced algorithms and assessment techniques necessary to cope with the projected multi-spectral threat and countermeasure environments for combat aircraft. Transferred from Project 2754 are those technology efforts required for command and control warfare, standoff jamming, and support countermeasures for denial, disruption, and suppression of adversary air defense operations. Included in these are: 1) advanced components and techniques needed to jam enemy radar; 2) novel electronic collection methods to inform the field commander of changes in the electronic environment; and 3) advanced standoff jammer technologies.

(U) FY 1997 (\$ in Thousands):

- (U) \$5,195 Develop technology to demonstrate low-cost (based on commercial processors and open architecture), off-board and on-board threat sensor fusion for situation awareness that meets needs for both new and existing aircraft.
- (U) Conducted preliminary flight demonstrations for hardware and software optimization of off-board and on-board threat sensor fusion technology.
- (U) Optimized hardware and algorithms/software in preparation for final demonstration of sensor fusion technology model.

(U) FY 1998 (\$ in Thousands):

- (U) \$2,341 Develop and investigate techniques to suppress adversary defense command and control networks.
- (U) Completed demonstrations of techniques to counter specific types of command and control warfare signals.
- (U) Completed development and demonstration of an approach to counter airborne navigation aids.
- (U) Fabricated and integrate components (based on new commercial technology) to demonstrate techniques to counter threat command and control processing nets/nodes.
- (U) Design and analyze advanced techniques for countering airborne navigation systems.
- (U) \$7,536 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$2,897 Develop low-cost (based on commercial processors and open architecture) technologies to demonstrate fusion of data (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aircraft.
- (U) Conduct hardware in loop demonstration of optimized sensor fusion technology within the existing avionics size, weight, and power constraints of a tactical aircraft.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603270F Electronic Combat (EC) Technology</b>	<b>2432</b>	
- (U) \$2,379	Develop and investigate command and control warfare electronic attack (EA) techniques to suppress and counter adversary command and control networks.		
- (U) \$524	- (U) Complete critical hardware/software designs; initiate fabrication of components for jamming modern digital command and control network links.		
- (U) \$5,800	- (U) Complete preliminary designs of EA techniques to counter advanced navigation systems.		
	Develop and evaluate advanced defensive techniques based on fusion of multiple information sources including defensive sensors, offensive sensors, off-board broadcast information, off-board data links, and cooperative off-board sensors.		
	- (U) Complete preliminary design of a combat information system that integrates defensive avionics functions.		
	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,578	Develop low-cost (based on commercial processors and open architecture) technologies to demonstrate fusion of data (e.g., threat, targeting, command and control, etc.) from off-board and on-board sensors to enhance situation awareness in both new and existing aircraft.		
	- (U) Optimize final Ada code for sensor fusion technology model for multiple platforms.		
- (U) \$5,593	- (U) Complete preliminary design trade offs for candidate techniques and algorithms via commercial technology architectures.		
	Develop and investigate command and control warfare EA techniques to suppress and counter adversary command and control networks.		
	- (U) Complete hardware/software integration of brassboard demonstration model and conduct ground/field testing against modern digital command and control network links.		
	- (U) Complete fabrication of preliminary EA demonstration model hardware; prepare ground/flight test parameters for demonstration against advanced telemetry links.		
- (U) \$7,171	- (U) Demonstrate laboratory EA technique to counter communications network nodes.		
	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603270F Electronic Combat (EC) Technology</b>	<b>2432</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>7,702</td> <td>6,222</td> <td>7,315</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>7,536</td> <td>5,800</td> <td>7,171</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	7,702	6,222	7,315	Cost	(U) Current Budget Submit/FY 1999 PB	7,536	5,800	7,171	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	7,702	6,222	7,315	Cost														
(U) Current Budget Submit/FY 1999 PB	7,536	5,800	7,171	Cont														
<p>(U) Change Summary Explanation:</p> <p>Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0604270F, Electronic Warfare (EW) Development.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>																		
<p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

Project 2432

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603270F Electronic Combat (EC) Technology								431G	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
431G	Radio Frequency (RF) Warning and Countermeasures	5,547	12,931	9,215	8,656	7,785	8,874	8,968	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project develops and demonstrates advanced technologies for radio frequency (RF) electronic countermeasures (ECM) suites to enhance survivability of air and space vehicles and to provide crew situation awareness. One major technology area addressed covers missile/aircraft warning, radar frequency receiver technologies, EC preprocessor technologies, advanced sorting/preprocessing algorithms, and expert software for applications on existing and future EC systems. Another technology area focuses on the development and demonstration of systems and components for generating the on-board/off-board RF countermeasure techniques. This includes the development of ECM techniques and as well as advanced ECM technologies such as antennas, power amplifiers, preamplifiers, etc. Note: In FY 1998, Congress added \$5.0 M for Precision Location and Identification technologies.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$644 Conduct risk reduction efforts for low-cost advanced radar and other RF emitters, and infrared (IR) warning concepts and techniques.</li> <li>- (U) Defined performance requirements for an advanced radar warning receiver operating in a complex RF environment.</li> <li>- (U) \$169 Developed design concepts for a digital RF receiver (cooperative effort with Navy).</li> <li>- (U) \$2,897 Developed algorithms which provide aircraft defensive systems with threat missile time-to-intercept data using sensor information from a passive, on-board IR missile warning receiver.</li> <li>- (U) \$2,897 Develop aircraft RF self-protection technology to counter the advanced RF threats associated with air defense weapon systems expected to be deployed over the next ten years.</li> <li>- (U) Continued cooperative efforts with the other Services and other countries to conduct tests to evaluate various RF countermeasure algorithm and/or hardware solutions.</li> <li>- (U) Identified promising solutions and design/fabricate technology to demonstrate approaches for countering RF threats.</li> <li>- (U) \$1,837 Develop technology for single aperture precision location and identification of ground and airborne RF emitters.</li> <li>- (U) Developed demonstration plans and integrate precision location hardware into technology demonstration aircraft.</li> <li>- (U) Completed flight demonstration of technology for single aperture precision location and identification of ground RF emitters and transition to users.</li> <li>- (U) \$5,547 Total</li> </ul>											

Project 431G

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603270F Electronic Combat (EC) Technology</b>	<b>February 1998</b>	<b>431G</b>
<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <p>- (U) \$2,224 Develop low-cost advanced radar and radio frequency (RF) emitter warning concepts and techniques.</p> <p>- (U) Conduct continuing demonstrations to establish benefits and effectiveness of evolving jam-on-pulse RF receiver technology.</p> <p>- (U) Initiate development of a wideband digital receiver for affordable electronic support measures (ESM) and radar warning receiver (RWR) suites based on PE 0602204F brassboard test.</p> <p>- (U) Complete design for an advanced antenna which improves antenna gain factor by a factor of ten at half the cost of current designs.</p> <p>- (U) Develop aircraft self-protection technologies to counter advanced RF threats associated with current and future air defense weapon systems.</p> <p>- (U) Complete preliminary design of critical flight-worthy technology components required to jam monopulse radar systems.</p> <p>- (U) Initiate design trade offs of RF hardware, software, and countermeasure techniques necessary to improve performance of current inventory RF countermeasure suites.</p> <p>- (U) \$4,058 Develop technology for multiaperture precision location and identification of ground and airborne RF emitters.</p> <p>- (U) Modify precision location and identification algorithm for use with antenna baselines of slow-moving, large aircraft.</p> <p>- (U) Complete initial design of common radar warning receiver subcomponent to reduce risk of transitioning precision location and identification technology to large aircraft.</p> <p>- (U) \$12,931 Total</p> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <p>- (U) \$2,868 Develop low-cost advanced radar and RF emitter warning concepts and techniques.</p> <p>- (U) Conduct continuing demonstrations to establish the benefits and effectiveness of evolving jam-on-pulse RF receiver technology.</p> <p>- (U) Complete design and fabricate wideband digital receiver for affordable ESM and RWR suites.</p> <p>- (U) Fabricate an advanced antenna that improves antenna gain by a factor of ten at half the cost of current designs.</p> <p>- (U) \$6,347 Develop aircraft self-protection technologies and support jamming technologies to counter advanced RF threats associated with current and future air defense weapon systems.</p> <p>- (U) Develop and demonstrate high risk technology for the monopulse angle jamming integrated electronic countermeasures (ECM) program.</p> <p>- (U) Complete design trade offs necessary for improving current inventory RF countermeasure suite performance through modification of ECM system configurations. Evaluate demonstration models.</p> <p>- (U) Develop steerable high-power array for self-protection and support jamming against high-power threats.</p> <p>- (U) Develop a multifunction, compact, modular ECM jammer.</p> <p>- (U) \$9,215 Total</p>			



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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603270F Electronic Combat (EC) Technology</b>	<b>431G</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>5,773</td> <td>8,873</td> <td>10,099</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>5,547</td> <td>12,931</td> <td>9,215</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	5,773	8,873	10,099	Cost	(U) Current Budget Submit/FY 1999 PB	5,547	12,931	9,215	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	5,773	8,873	10,099	Cost														
(U) Current Budget Submit/FY 1999 PB	5,547	12,931	9,215	Cont														
<p>(U) Change Summary Explanation:  Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0604270F, Electronic Warfare (EW) Development.</li> <li>- (U) PE 0604270N, EW Development.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>																		
<p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603270F Electronic Combat (EC) Technology								691X	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
691X	Electro-Optical/Infrared (EO/IR) Warning and Countermeasures	13,050	13,809	9,167	10,889	13,303	11,119	11,119	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical (EO), infrared (IR), and laser threat systems. The off-board (decoys and expendables) and on-board countermeasure technologies developed provide robust, affordable solutions for protection against IR missiles with autonomous seekers, multi-spectral threats, laser-guided weapons and EO/IR tracking systems used to direct EO/IR/radio frequency (RF) missiles. Countermeasure capability against advanced EO, IR, and laser-guided threats are vital for operational aircraft survival in wartime, peacekeeping, and supply mission environments. Note: In FY 1998, Congress added \$3.75M for Closed-Loop Infrared Countermeasures technology.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"><li>- (U) \$10,705 Develop threat-adaptable, laser-based infrared countermeasure (IRCM) technology for large aircraft to defeat current and future IR missiles in multiple threat scenarios.</li><li>- (U) Continued tower testing of threat-adaptable laser-based IRCM jamming techniques and evaluated their potential to defeat IR missiles in accordance with the joint-Service demonstration plan.</li><li>- (U) Conducted live fire field demonstration of static, closed-loop IRCM brassboard against air-to-air missiles at White Sands Missile Range's North Obscura Peak.</li><li>- (U) Developed and demonstrated closed-loop IRCM technologies under laboratory and field conditions necessary for continued risk reduction.</li><li>- (U) Continued to conduct hardware-in-the-loop tests in-house to analyze threat missile operations, developed countermeasure techniques, and assisted in developing digital models of potential threat seekers.</li></ul> <p>Develop laser-based electro-optical (EO)/IRCM technology to defeat advanced day/night vision EO/IR acquisition/tracking sensors on threat air defense weapon systems.</p> <ul style="list-style-type: none"><li>- (U) Conducted threat analysis, vulnerability studies, and associated experiments to determine optimum countermeasure techniques for threat EO/IR acquisition/tracking sensors.</li></ul> <p>Develop IR missile warning technology for product improvement of existing and new aircraft-installed equipment, lowering life cycle costs and improving performance to meet the critical need of detecting advanced, lower signature threats.</p> <ul style="list-style-type: none"><li>- (U) Completed design for an IR missile warning subsystem which utilizes an advanced IR sensor array that eliminates the expensive cryogenic cooling requirement.</li><li>- (U) Completed evaluation of a temporal algorithm with a commercial image processor for IR missile warning applications.</li></ul>											

Project 691X

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT 691X	
3 - Advanced Technology Development		0603270F Electronic Combat (EC) Technology	
- (U) \$1,130	Develop integrated multi-spectral countermeasure expendables for infrared (IR) and dual mode (IR/radio frequency (RF)) seeker threats.		
- (U) \$13,050	- (U) Completed critical design and fabricated test samples of IR expendables which defeat non-imaging threat missiles.		
- (U) \$13,050	- (U) Analyzed technologies to counter enemy dual mode missile seekers.		
- (U) \$13,050	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$12,270	Develop on-board threat adaptable, laser-based infrared countermeasure (IRCM) technology and off-board (active decoy) technology to defeat current and future IR missiles in multiple scenarios.		
- (U) \$1,069	- (U) Continue tower testing threat adaptable, laser-based jamming codes to defeat specific threat IR missiles in accordance with the joint-Service demonstration plan.		
- (U) \$1,069	- (U) Complete fabrication and integration of brassboard hardware to demonstrate closed-loop, laser-based IRCM for large aircraft.		
- (U) \$1,069	Initiate live fire testing at White Sands aerial cable car facility using closed-loop IRCM testbed.		
- (U) \$1,069	- (U) Continue to conduct hardware-in-the-loop and digital simulation experiments to analyze threat missile operations, develop countermeasure techniques, and assist in developing and refining digital models of potential threat infrared seekers.		
- (U) \$1,069	- (U) Conduct field test demonstration of signature management countermeasures against advanced imaging IR missile seekers.		
- (U) \$1,069	- (U) Develop and fabricate a two-color missile warning sensor to hand off missile detection to the countermeasure subsystem.		
- (U) \$1,069	- (U) Develop miniature pointer-tracker to reduce risk of employment of closed-loop IRCM testbed on a large aircraft.		
- (U) \$1,069	Develop the laser warning and countermeasure technologies necessary to defeat advanced day/night electro-optical (EO)/IR acquisition/tracking sensors on threat air defense systems. These technologies include on-board and off-board (expendable jammers), EO/laser countermeasures, and precision guided weapon countermeasures.		
- (U) \$1,069	- (U) Complete development and laboratory testing of techniques for detection of beamrider missiles.		
- (U) \$1,069	- (U) Complete threat analysis and initiate design of laser-based countermeasure concepts to defeat EO/IR tracking systems used to direct a wide variety of weapons.		
- (U) \$1,069	- (U) Develop non-mechanical beam steering technologies for EO, laser, and IR countermeasures.		
- (U) \$470	- (U) Complete threat definition and initiate design of IR/RF decoy concepts to negate multi-mode threat seekers.		
- (U) \$470	Develop IR missile warning technologies for product improvement of existing and new aircraft-installed equipment. These technologies will lower life cycle costs and improve the performance required to detect advanced, low signature threat missiles.		
- (U) \$470	- (U) Evaluate uncooled IR focal plane arrays for use in lower-cost passive threat warning devices.		
- (U) \$470	- (U) Evaluate commercial image processor for use in running IR threat warning algorithms in real-time.		
- (U) \$13,809	- (U) Design sensors and algorithms for missile warning, situational awareness, and defensive infrared search and track.		
- (U) \$13,809	Total		

Project 691X

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Exhibit R-2 (PE 0603270F)

Project 691X

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Exhibit R-2 (PE 0603270F)

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603270F Electronic Combat (EC) Technology

691X

## (U) FY 1999 (\$ in Thousands):

- (U) \$6,267 Develop on-board threat adaptable, laser-based infrared countermeasure (IRCM) technology and off-board (active decoy) technology to defeat current and future infrared (IR) missiles in multiple scenarios.
  - (U) Continue tower testing threat-adaptable, laser based jamming techniques to defeat IR missiles in accordance with the joint-Service demonstration plan.
  - (U) Conduct live-fire IR missile firing at White Sands Missile Range against the technology demonstration hardware developed for a threat-adaptable, laser-based IR countermeasure system for large aircraft.
  - (U) Design, fabricate, and begin integration of flight-worthy closed-loop laser IRCM for flight demonstrations on a C-17 or surrogate large aircraft to support risk reduction efforts for development of an affordable, closed-loop laser IRCM system.
  - (U) Continue to conduct in-house experiments to analyze the latest acquired threat missile operation, develop countermeasure techniques, and assist in developing digital models of potential threat IR seekers.
  - (U) Complete development and integration of a new target simulator for imaging IR seekers.
  - (U) Continue development of a reduced-sized, threat-adaptable, laser-based IR countermeasure concept for tactical combat aircraft.
  - (U) Complete development of IR imaging countermeasure concept and laboratory demonstration.
  - (U) Continue the development of hardware for field demonstration of countermeasures against advanced imaging IR missile seekers.
- (U) \$1,998 Develop the laser warning and countermeasure technologies necessary to defeat advanced day/night electro-optical (EO)/infrared (IR) acquisition/tracking sensors on threat air defense systems. These technologies include on-board and off-board (expendable jammers), EO/laser countermeasures, and precision guided weapon countermeasures.
  - (U) Continue development of countermeasure concepts to defeat newly developed EO/IR tracking systems.
  - (U) Continue development of gimballess beam steering technologies that have applications to EO laser and IR countermeasures.
  - (U) Develop advanced countermeasure technologies to defeat anti-aircraft laser aided/guided weapon systems.
  - (U) Continue development and complete threat modeling technologies to counter enemy dual mode missile seekers.
  - (U) Develop cooperative on-board and off-board countermeasures using decoys and expendables.
- (U) \$902 Develop IR missile warning technologies for product improvement of existing and new aircraft-installed equipment. These technologies will lower life cycle costs and improve the performance required to detect advanced, low signature threat missiles.
  - (U) Complete design and fabrication of distributed aperture demonstration hardware sensors and processors for real-time processing demonstration of multiple passive functions (missile warning, forward looking IR (FLIR) navigation, defensive IR search-track).
  - (U) Develop clutter rejection techniques for man-made false-alarm sources in IR threat warning.
- (U) \$9,167 Total

Project 691X

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Exhibit R-2 (PE 0603270F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603270F Electronic Combat (EC) Technology</b>	<b>691X</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>12,939</td> <td>10,526</td> <td>9,351</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>13,050</td> <td>13,809</td> <td>9,167</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	12,939	10,526	9,351	Cost	(U) Current Budget Submit/FY 1999 PB	13,050	13,809	9,167	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	12,939	10,526	9,351	Cost														
(U) Current Budget Submit/FY 1999 PB	13,050	13,809	9,167	Cont														
<p>(U) Change Summary Explanation:</p> <p>Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0604270F, Electronic Warfare (EW) Development.</li> <li>- (U) PE 0604270N, EW Development.</li> <li>- (U) PE 0603203F, Avionics for Aerospace Vehicles.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>																		
<p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603302F Space and Missile Rocket Propulsion									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		22,137	17,249	21,121	21,622	21,332	21,548	22,694	Continuing	Continuing	
0003 Launch Vehicle Technology		587	631	588	586	663	615	654	Continuing	Continuing	
4373 Launch and Orbit Transfer Propulsion Technology		19,328	14,844	18,723	19,229	19,152	19,408	20,504	Continuing	Continuing	
6339 Tactical Propulsion Technology		297	320	294	293	0	0	0	Continuing	Continuing	
6340 Satellite Control and Maneuvering Propulsion Technology		1,925	1,454	1,516	1,514	1,517	1,525	1,536	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates advanced rocket propulsion and space launch technologies. This program provides the technological step necessary to transition the most promising rocket propulsion and space launch technologies to applications using full-scale, proof-of-principle demonstrations. The projects within this program are structured to support Air Force Space Command's and Air Combat Command's mission area requirements for space and missile technologies which include the goals established in the Integrated High Payoff Rocket Propulsion Technology Initiative, a multi-agency/industry effort to focus the development of U.S. rocket propulsion technology.

New and improved components will be integrated with the environmentally improved propellants developed in this program to create new propulsion systems for the next generation of launch vehicles and satellites. Anticipated technological advances in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. In a reusable launch system, the anticipated improvements are an increase in payload capability of 170% and a reduction in launch and O&S costs of 79%. The advances in propulsion in this program result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative. The development of these technologies has been coordinated with National Aeronautics and Space Administration (NASA) to eliminate duplication of efforts. The space launch and missile propulsion industry will leverage the technologies from this program to enhance the country's industrial competitiveness.

Note: Congress added \$5 million for Integrated High Payoff Rocket Propulsion Technology (IHPRT), \$2 million for Pentaborane Disposal, and \$3 million for Scorpions in FY 1997 which explains the perceived decrease in FY 1998. Investments in tactical propulsion technology in FYs 2001 and out are being evaluated at this time. In FYs 1999 and out, additional emphasis has been placed on space launch technology.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>		<b>0603302F Space and Missile Rocket Propulsion</b>		
(U) <u>B. Program Change Summary (\$ in Thousands):</u>				
		FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 1998 PB)		22,353	16,247	22,037
(U) Appropriated Value		23,240	18,147	
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions		-488	-609	
b. SBIR		-399	-289	
c. Omnibus/Other Above Threshold Reprogrammings				
d. Below Threshold Reprogrammings		-178		
e. Rescissions		-38		
(U) Adjustments to Budget Year Since FY 1998 PB				-916
(U) Current Budget Submit/FY 1999 PB		22,137	17,249	21,121
				Cont
(U) Change Summary Explanation:				
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.				
Schedule: Not Applicable.				
Technical: Not Applicable				
(U) <u>C. Other Program Funding Summary:</u> Not Applicable.				
(U) <u>D. Schedule Profile:</u> Not Applicable.				

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603302F Space and Missile Rocket Propulsion

PROJECT

0003

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0003 Launch Vehicle Technology		587	631	588	586	663	615	654	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops advanced and innovative launch vehicle technologies in the areas of structures (i.e., fairings, interstages, struts, thermal protection systems, etc.), tanks, and operations.

## (U) FY 1997 (\$ in Thousands):

- (U)	\$150	Continued to define technological needs for future reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U)	\$70	Continued to define technological needs for future expendable launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U)	\$367	Fabricated test article for future launch vehicles, using and validating techniques that promise up to 40% weight reduction and 30-60% cost reduction.
- (U)	\$587	Total

## (U) FY 1998 (\$ in Thousands):

- (U)	\$130	Continue to define technological needs for future reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U)	\$60	Continue to define technological needs for future expendable launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U)	\$441	Complete fabrication and qualification of full-size advanced composite interstages for future launch vehicles, using and validating techniques that promise up to 40% weight reduction and 30-60% cost reductions.
- (U)	\$631	Total

Project 0003

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Exhibit R-2 (PE 0603302F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603302F Space and Missile Rocket Propulsion

PROJECT

0003

## (U) FY 1999 (\$ in Thousands):

- (U) \$150 Continue to define technological needs for future reusable military launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U) \$100 Continue to define technological needs for future expendable launch vehicles including operations technologies, lightweight airframe structures, durable composite cryogenic tanks, and all-weather thermal protection.
- (U) \$338 Initiate lightweight acoustically damped payload shroud development effort for eventual technology transfer to Evolved Expendable Launch Vehicle (EELV.)
- (U) \$588 Total

## (U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	588	663	663	Cost
(U) Current Budget Submit/FY 1999 PB	587	631	588	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

## (U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603401F, Advanced Spacecraft Technology.
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

## (U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603302F Space and Missile Rocket Propulsion

PROJECT

4373

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4373 Launch and Orbit Transfer Propulsion Technology	19,328	14,844	18,723	19,229	19,152	19,408	20,504	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops advanced and innovative, low-cost rocket turbomachinery and components, low-cost space and missile launch propulsion system manufacturing technologies, and advanced propellants. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, reduced operation and launch costs, and increased life and performance of propulsion systems are emphasized in this project. Technological advances developed in this program will improve the performance of expendable systems' payload capabilities by 21% and reduce the launch and operations and support (O&S) costs by 28%. The advances in propulsion in this program will result from the achievement of the 2010 goals of the Integrated High Payoff Rocket Propulsion Technology Initiative.

## (U) FY 1997 (\$ in Thousands):

- (U) \$3,294 Developed advanced, environmentally acceptable propellants technology for current and future launch systems.
- (U) Published final report assessing the increased performance benefits of a new, non-toxic chlorine-free propellant for replacement of current propellants in solid launch systems.
- (U) Continued studying current and proposed environmental regulations for their impact on the manufacturing of large-scale solid rocket booster propellants.
- (U) \$2,000 Began disposal of pentaborane.
- (U) \$12,858 Developed propulsion technologies for existing and future launch vehicles.
- (U) Integrated fluid film bearing technologies into the oxygen and hydrogen rocket turbopumps, increasing liquid-booster propulsion performance.
- (U) Began development of advanced, lightweight, thrust chamber components to be integrated with rocket turbopumps and preburners.
- (U) Designed and fabricated a complete thrust chamber with extended thermal-cycle life, decreased system costs, and increased liquid engine reliability that will be used in boost and orbit transfer missions.
- (U) \$1,176 Developed propulsion technologies for Advanced Orbit Transfer Vehicles
- (U) Developed High Power Hall Thruster Technologies
- (U) Developed technologies for use in Pulsed Plasma Thrusters
- (U) \$19,328 Total

Project 4373

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603302F Space and Missile Rocket Propulsion

4373

## (U) FY 1998 (\$ in Thousands):

- (U)	\$9,503	Develop propulsion technologies for existing and future launch vehicles.
- (U)		- (U) Continue fabrication of turbopump assemblies and begin testing in relative environment.
- (U)	\$1,341	- (U) Continue development of advanced lightweight thrust chamber components for integration into advanced liquid booster.
		Develop propulsion technologies for existing and future upperstage and orbit transfer vehicles.
- (U)		- (U) Complete design and begin fabrication and assembly of a high pressure liquid oxygen/hydrogen upperstage engine.
- (U)		- (U) Design High Performance Hall Thruster for orbital transfer vehicle (OTV).
- (U)	\$4,000	- (U) Design Pulsed Plasma Thruster for MightySat demonstration.
- (U)	\$14,844	Develop technologies for the sustainment of strategic systems.
- (U)		Total

## (U) FY 1999 (\$ in Thousands):

- (U)	\$12,478	Develop propulsion technologies for existing and future launch vehicles.
- (U)		- (U) Complete testing of turbopump assembly and preburner components for integration into an advanced liquid booster.
- (U)	\$2,245	- (U) Complete assembly and engine testing of a 1200 psi liquid oxygen/hydrogen upperstage engine.
		Develop propulsion technologies for existing and future upperstage and orbit transfer vehicles.
- (U)		- (U) Complete assembly and engine testing of a high pressure liquid oxygen/hydrogen upperstage engine.
- (U)		- (U) Design High Performance Hall Thruster for OTV.
- (U)	\$4,000	- (U) Design Pulsed Plasma Thruster for MightySat demonstration.
- (U)	\$18,723	Develop technologies for the sustainment of strategic systems.
- (U)		Total

Project 4373

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603302F Space and Missile Rocket Propulsion</b>	<b>4373</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>19,526</td> <td>13,707</td> <td>19,488</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>19,328</td> <td>14,844</td> <td>18,723</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	19,526	13,707	19,488	Cost	(U) Current Budget Submit/FY 1999 PB	19,328	14,844	18,723	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	19,526	13,707	19,488	Cost														
(U) Current Budget Submit/FY 1999 PB	19,328	14,844	18,723	Cont														
<p>(U) Change Summary Explanation:</p> <p>Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602601F, Phillips Laboratory.</li> <li>- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>																		
<p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

Project 4373

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE		February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT			
3 - Advanced Technology Development		0603302F Space and Missile Rocket Propulsion								6339			
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost			
6339	Tactical Propulsion Technology	297	320	294	293	0	0	0	Continuing	Continuing			
<p><b>(U) A. Mission Description and Budget Item Justification:</b> This project develops highly energetic propellants and propulsion systems. Improved case, insulation, and propellant interfaces as well as better performing nozzles will be developed. Technology such as thrust vector control, thrust modulation, signature characterization, and signature reduction will be developed in this project. The emphasis in this project is on rocket propulsion system affordability, weight reduction. Anticipated payoffs from these developments, identified through the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT), include a 49% range increase, 50% size reduction, 100% payload increase, and 21% reduction in time-to-target.</p> <p><b>(U) FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$99 Developed, in lab-size quantities, propellants that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.</li> <li>- (U) \$99 After developing the propellants, tested characteristics of propellants in lab-size quantities.</li> <li>- (U) \$99 In conjunction with propellant development, developed and characterized, in lab-size quantities, components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.</li> <li>- (U) Demonstrated environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.</li> <li>- (U) \$297 Total</li> </ul> <p><b>(U) FY 1998 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$107 Develop, in lab-size quantities, propellants that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.</li> <li>- (U) \$107 After developing the propellants, test characteristics of propellants in lab-size quantities.</li> <li>- (U) \$106 In conjunction with propellant development, develop and characterize, in lab-size quantities, components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.</li> <li>- (U) Integrate component technologies and hardware for environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.</li> <li>- (U) \$320 Total</li> </ul>													

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>		<b>0603302F Space and Missile Rocket Propulsion</b>	<b>6339</b>

(U) FY 1999 (\$ in Thousands):

- (U)	\$98	Develop, in lab-size quantities, propellants that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.
- (U)	\$98	After developing the propellants, test characteristics of propellants in lab-size quantities.
- (U)	\$98	In conjunction with propellant development, develop and characterize, in lab-size quantities, components that can be incorporated into the design and manufacturing of missile systems that will result in higher performance, lower environmental impacts, and reduced signature characteristics.
- (U)	\$294	- (U) Integrate component technologies and hardware for environmentally acceptable, reduced smoke, low-erosion tactical missile propellants and components that improve missile thrust and reduce plume signatures.
- (U)		Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603302F Space and Missile Rocket Propulsion</b>	<b>6339</b>	
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		298	336
(U) Current Budget Submit/FY 1999 PB		297	320
			FY 1999
			340
			294
		Total	
		Cost	
		Cont	
		Cont	
<b>(U) Change Summary Explanation:</b>			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
- (U) PE 0602601F, Phillips Laboratory.			
- (U) PE 0602303A, Missile Technology.			
- (U) PE 0603313A, Missile and Rocket Advanced Technology.			
- (U) PE 0603792N, Advanced Technology Transition.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
<b>(U) D. Schedule Profile: Not Applicable.</b>			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603302F Space and Missile Rocket Propulsion								6340	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
6340	Satellite Control and Maneuvering Propulsion Technology	1,925	1,454	1,516	1,514	1,517	1,525	1,536	Continuing	Continuing	
<p>(U) <u>A. Mission Description and Budget Item Justification:</u> Chemical, electric, and solar rocket propulsion system technologies for station keeping and on-orbit maneuvering applications are developed in this project. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy chemical propellants. The payoffs for the Integrated High Payoff Rocket Propulsion Technology Initiative (IHPRPT) include a seven-year increase in satellite on-orbit time, a 50% increase in satellite maneuvering capability, a 25% reduction in orbit transfer operational costs, and a 15% increase in satellite payload.</p>											
<p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"><li>- (U) \$1,237 Demonstrated solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology.</li><li>- (U) \$100 Supported launch and space demonstration of the 30 kilowatt (kW) ammonia arcjet thruster.</li><li>- (U) Demonstrated solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology.</li><li>- (U) Analyzed data from 30kW Ammonia arcjet thruster.</li><li>- (U) \$588 Demonstrated solar thermal propulsion technologies for orbit transfer and maneuvering propulsion technology.</li><li>- (U) Designed the Solar Thermal Balloon Flight experiment.</li><li>- (U) \$1,925 Total</li></ul>											
<p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"><li>- (U) \$288 Demonstrate solar electric propulsion technologies for orbit transfer and maneuvering propulsion technology.</li><li>- (U) Analyze data from 30kW Ammonia arcjet thruster.</li><li>- (U) Draft final report for 30kW Ammonia arcjet thruster.</li><li>- (U) \$254 Demonstrate solar thermal propulsion technologies for orbit transfer and maneuvering propulsion technology.</li><li>- (U) Fabricate components for the Solar Thermal Balloon Flight Experiment</li><li>- (U) \$912 Demonstrate post-boost vehicle strategic sustainment technologies.</li><li>- (U) Begin development of post boost vehicle component technologies.</li><li>- (U) \$1,454 Total</li></ul>											

Project 6340

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Exhibit R-2 (PE 0603302F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603302F Space and Missile Rocket Propulsion

PROJECT 6340

## (U) FY 1999 (\$ in Thousands):

- (U) \$516 Demonstrate solar thermal propulsion technologies for orbit transfer and maneuvering propulsion technology.
- (U) \$500 (U) Begin testing and analyze performance, life, and integration improvements for the Solar Thermal Balloon Flight Experiment
- (U) \$500 Demonstrate post-boost vehicle strategic sustainment technologies.
- (U) \$500 (U) Continue development of post-boost vehicle component technologies.
- (U) \$1,516 Demonstrate post-boost vehicle strategic sustainment technologies.
- (U) \$1,516 (U) Continue development of post-boost vehicle propellant technologies.
- (U) \$1,516 Total

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	1,941	1,541	1,546	Cost
(U) Current Budget Submit/FY 1999 PB	1,925	1,454	1,516	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 6340

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Exhibit R-2 (PE 0603302F)

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PE NUMBER: 0603311F

UNCLASSIFIED

PE TITLE: Ballistic Missile Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603311F Ballistic Missile Technology								4091	
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4091 Missile Electronics		3,253	7,537	0	0	0	0	0	10,740	TBD	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This Advanced Technology Development program funds the development, and particularly the integrated demonstration, of advanced guidance, navigation, and control packages for ballistic missiles. These technologies are flown as Missile Technology Demonstration flights. Efforts directly support strategic force sustainment, space force applications, and space navigation. Also funded are upgrades for range and safety instrumentation for ballistic missiles. Emphasis is on technologies which increase safety, reduce maintenance, and improve reliability of the currently deployed intercontinental ballistic missile (ICBM) force at a lower life cycle cost. Future precision guidance and navigation technologies are demonstrated on sounding rocket and ICBM flights that support conventional ballistic missiles and hard and deeply buried target defeat capability technology needs. Note: This program was eliminated at the end of FY 1997, however, Congress added funds for Missile Technology Demonstration (MTD) flight testing and Radiation Hardened Electronics in FY 1998.</p> <p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$927 Developed advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems and develop precision navigation systems for future ICBM-delivered conventional munitions.</li> <li>- (U) Tested advanced solid state navigation technology in a laboratory environment and on a sounding rocket for precision strike applications.</li> <li>- (U) \$2,326 Developed advanced navigation technology to support range instrumentation and improve safety requirements.</li> <li>- (U) Integrated and tested Global Positioning System (GPS)-based navigation packages coupled directly with Inertial Navigation Systems (INS) to improve the accuracy, range, and safety of reentry vehicles for experimentation on missile test ranges.</li> <li>- (U) \$3,253 Total</li> </ul>											

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Exhibit R-2 (PE 0603311F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603311F Ballistic Missile Technology</b>	<b>4091</b>	

(U) FY 1998 (\$ in Thousands):

- |       |         |                                                                                                                                                                                                                                                                               |
|-------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| - (U) | \$4,272 | Develop advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems and develop precision navigation systems for future intercontinental ballistic missile (ICBM)-delivered conventional munitions. |
| - (U) | \$250   | - (U) Begin development, integration, and testing of advanced solid state navigation technology for ICBM and space applications.                                                                                                                                              |
| - (U) | \$715   | Develop advanced navigation technology to support range instrumentation and improve safety requirements.                                                                                                                                                                      |
| - (U) |         | - (U) Begin development, integration, and testing of the Global Positioning System (GPS)-based navigation packages coupled directly with Inertial Navigation Systems (INS) to improve the accuracy, range, and safety of ballistic missiles and space systems.                |
| - (U) |         | Develop radiation hardened analog circuit technology for missile guidance systems.                                                                                                                                                                                            |
| - (U) |         | - (U) Design and fabricate a twelve-bit analog converter.                                                                                                                                                                                                                     |
| - (U) | \$2,300 | - (U) Stimulate a new second source supplier for radiation hardened analog components.                                                                                                                                                                                        |
| - (U) |         | Improve radiation hardened digital circuit fabrication process to facilitate evolutionary missile technology.                                                                                                                                                                 |
| - (U) |         | - (U) Establish new design tools for miniaturizing radiation hardened computer components.                                                                                                                                                                                    |
| - (U) |         | - (U) Initiate design effort to decrease digital circuit size by 50% while keeping pace with commercial computer performance.                                                                                                                                                 |
| - (U) | \$7,537 | Total                                                                                                                                                                                                                                                                         |

(U) FY 1999: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603311F Ballistic Missile Technology</b>	<b>4091</b>	
<b>(U) B. Program Change Summary (\$ in Thousands):</b>			
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		2,699	0
(U) Appropriated Value		2,828	8,000
(U) Adjustments to Appropriated Value			
a. Congressional/General Reductions		-61	-262
b. SBIR		-68	-201
c. Omnibus/Other Above Threshold Reprogrammings		-6	
d. Below Threshold Reprogrammings		565	
e. Rescissions		-5	
(U) Adjustments to Budget Year Since FY 1998 PB			
(U) Current Budget Submit/FY 1998 PB		3,253	7537
			0
			TBD
<b>(U) Change Summary Explanation:</b>			
Funding: Due to higher priorities within the Science and Technology (S&T) Program, this project was scheduled to be terminated at the end of FY 1997, however, Congress added funds in FY 1998.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
<b>(U) C. Other Program Funding Summary:</b>			
<b>(U) Related Activities:</b>			
-	(U) PE 0602204F, Aerospace Avionics.		
-	(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.		
<b>(U) D. Schedule Profile: Not Applicable.</b>			

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PE NUMBER: 0603401F

UNCLASSIFIED

PE TITLE: Advanced Spacecraft Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603401F Advanced Spacecraft Technology									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	72,925	54,899	42,571	47,005	50,961	53,980	53,781	Continuing	Continuing	
1026	Space Structures and Controls Technology	1,058	940	1,788	3,181	3,937	3,516	3,571	Continuing	Continuing	
2181	Space Electronics and Software Technology	11,975	12,707	12,982	14,758	13,996	15,182	13,375	Continuing	Continuing	
3784	Space Sensors and Satellite Communication Technology	2,177	2,710	1,760	3,556	4,273	3,865	3,930	Continuing	Continuing	
3834	Integrated Space Technology Demonstrations	37,847	17,739	20,447	18,255	19,034	20,780	21,867	Continuing	Continuing	
4400	Satellite Survivability Technology	5,734	5,310	826	1,294	2,021	3,271	3,514	Continuing	Continuing	
4599	Reusable Launch Vehicle Technology	9,579	11,715	0	0	0	0	0	TBD	TBD	
682J	Space Power and Thermal Management Technology	4,555	3,778	4,768	5,961	7,700	7,366	7,524	Continuing	Continuing	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This Advanced Technology Development program develops advanced spacecraft technologies such as structures, electronics, thermal, power, and sensors; and demonstrates them in an appropriate fashion (i.e., component or system, ground, or flight). The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable launch vehicle technologies; (2) advanced space structures and structural controls; (3) hardened space electronics and satellite control software; (4) advanced passive/active space-based sensors and satellite communications; (5) compact, low-cost space power and thermal management; and (6) satellite survivability. Note: Congress added \$37 million in FY 1997 (\$10 million for Reusable Launch Vehicle (RLV) technology, \$25 million for Microsat development, and \$2 million for Miniature Threat Reporting System) and \$17.5 million in FY 1998 (\$5 million for Low-Cost Launch Vehicle Technologies [previously funded in PE 0603302F/0634373], \$7.5 million for Solar Thermionics Orbital Transfer Vehicle, and \$5 million for Miniature Threat Reporting System) which explains the perceived decrease in FYs 1999 and out. In FYs 1999 and out, additional emphasis has been placed on evolutionary growth in space technologies. Funds added by the Congress in FY 1998 for RLV (Military Spaceplane) and Microsat (Clementine 2) were line item vetoed by the President. Note: Project 4599 was previously called Project 0003, Reusable Launch Vehicle Technology. However, in FY 1996, this project was moved to PE 0603302F, Space and Missile Launch Technology, and renamed Launch Vehicle Technology to allow for Air Force investigation of all reusable and expendable launch technologies. In FY 1997, the only funds remaining in Project 0003 in PE 0603401F were the funds added by Congress specifically for Reusable Launch Vehicle technology. To avoid confusion with Project 0003, Launch Vehicle Technology, in PE 0603302F, Project 0003 in PE 0603401F was renumbered Project 4599, keeping its Reusable Launch Vehicle title. In FY 1998, the low-cost launch vehicle technology development program was moved from PE 0603302F, Project 4373, to this project.</p>											

Exhibit R-2 (PE 0603401F)

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(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops advanced spacecraft technologies such as structures, electronics, thermal, power, and sensors; and demonstrates them in an appropriate fashion (i.e., component or system, ground, or flight). The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable launch vehicle technologies; (2) advanced space structures and structural controls; (3) hardened space electronics and satellite control software; (4) advanced passive/active space-based sensors and satellite communications; (5) compact, low-cost space power and thermal management; and (6) satellite survivability. Note: Congress added \$37 million in FY 1997 (\$10 million for Reusable Launch Vehicle (RLV) technology, \$25 million for Microsat development, and \$2 million for Miniature Threat Reporting System) and \$17.5 million in FY 1998 (\$5 million for Low-Cost Launch Vehicle Technologies [previously funded in PE 0603302F/0634373], \$7.5 million for Solar Thermionics Orbital Transfer Vehicle, and \$5 million for Miniature Threat Reporting System) which explains the perceived decrease in FYs 1999 and out. In FYs 1999 and out, additional emphasis has been placed on evolutionary growth in space technologies. Funds added by the Congress in FY 1998 for RLV (Military Spaceplane) and Microsat (Clementine 2) were line item vetoed by the President. Note: Project 4599 was previously called Project 0003, Reusable Launch Vehicle Technology. However, in FY 1996, this project was moved to PE 0603302F, Space and Missile Launch Technology, and renamed Launch Vehicle Technology to allow for Air Force investigation of all reusable and expendable launch technologies. In FY 1997, the only funds remaining in Project 0003 in PE 0603401F were the funds added by Congress specifically for Reusable Launch Vehicle technology. To avoid confusion with Project 0003, Launch Vehicle Technology, in PE 0603302F, Project 0003 in PE 0603401F was renumbered Project 4599, keeping its Reusable Launch Vehicle title. In FY 1998, the low-cost launch vehicle technology development program was moved from PE 0603302F, Project 4373, to this project.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	
<b>3 - Advanced Technology Development</b>		
<b>0603401F Advanced Spacecraft Technology</b>		
<b>(U) B. Program Change Summary (\$ in Thousands):</b>		
	FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)	73,215	40,846
(U) Appropriated Value	76,637	98,346
(U) Adjustments to Appropriated Value		
a. Congressional/General Reductions	-1,728	-2,112
b. SBIR	-1,694	-1,335
c. Omnibus/Other Above Threshold Reprogrammings		
d. Below Threshold Reprogrammings	-290	
e. Recissions		
f. Line Item Veto		-40,000
(U) Adjustments to Budget Year Since FY 1998 PB		-2,108
(U) Current Budget Submit/FY 1999 PB	72,925	42,571
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
<b>(U) C. Other Program Funding Summary:</b> Not Applicable.		
<b>(U) D. Schedule Profile:</b> Not Applicable.		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

1026

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1026 Space Structures and Controls Technology	1,058	940	1,788	3,181	3,937	3,516	3,571	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project demonstrates advanced composite structures and structural control technologies for future Air Force space and missile systems. Prior to FY 1995, the Air Force relied on Ballistic Missile Defense Organization (BMDO) funding to address its needs in this technology area. As BMDO budgets have declined, so has their funding in this area, necessitating an increased Air Force investment to maintain critical spacecraft structures and controls technologies. Advanced space structure component efforts focus on the demonstration of new composite structure technologies. The goal is to significantly improve the payload mass fraction and reduce overall spacecraft fabrication time and cost. This project also pays for the development of advanced passive and active spacecraft structural control technologies. Structural vibration and shock suppression technologies are intended to significantly enhance space platform stability, improving the focusing/imaging ability of space-based optical components such as focal plane arrays developed in Project 3784 or solar cells developed in Project 682J.

## (U) FY 1997 (\$ in Thousands):

-- (U)	\$484	Developed advanced spacecraft structure technologies.
-- (U)		Completed first phase of multifunctional structure technology demonstration.
-- (U)		Developed advanced lightweight spacecraft structure for MightySat.
-- (U)	\$244	Developed advanced spacecraft structural control and mechanisms technologies.
-- (U)		Completed first phase of joint technology demonstration program to isolate sensitive payloads from on-orbit disturbances. System to be flight demonstrated on Space Test Research Vehicle 2 (STRV2.)
-- (U)		Continued joint program to develop advanced mechanisms which will revolutionize the design of solar array subsystems. System will be flight demonstrated in FY 1999 as part of National Aeronautics and Space Administration (NASA) Earth Observation-1 (EO-1) mission.
-- (U)	\$330	Developed advanced spacecraft launch vibration isolation system.
-- (U)		Completed preliminary design of launch vibration isolation system. System to support first military Evolved Expendable Launch Vehicle (EELV) launch in FY 2001.
-- (U)	\$1,058	Total

Project 1026

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

1026

## (U) FY 1998 (\$ in Thousands):

- (U)	\$21	Develop advanced spacecraft structure technologies.
- (U)		- (U) Initiate conformal grid stiffened cryogenic propellant tank program.
- (U)	\$340	Develop advanced spacecraft structural control and mechanisms technologies.
- (U)		- (U) Complete flight demonstration program to isolate sensitive payloads from on-orbit disturbances on Space Test Research Vehicle 2 (STRV2.)
- (U)		- (U) Complete joint program to develop advanced mechanisms which will revolutionize the design of solar array subsystems. System will be flight demonstrated in FY 1999 as part of National Aeronautics and Space Administration (NASA) Earth Observation-1 (EO-1) mission.
- (U)	\$579	Develop advanced spacecraft launch vibration isolation system.
- (U)		- (U) Complete design of launch vibration isolation system and begin fabrication to support first military Evolved Expendable Launch Vehicle (EELV) launch in FY 2001.
- (U)	\$940	Total

## (U) FY 1999 (\$ in Thousands):

- (U)	\$755	Develop advanced spacecraft structures technologies.
- (U)		- (U) Initiate lightweight space-based antenna structure flight experiment.
- (U)	\$441	Develop advanced spacecraft structural control and mechanisms technologies.
- (U)		- (U) Complete flight demonstration of component isolation system program to isolate sensitive payloads from on-orbit disturbances.
- (U)	\$592	- (U) Fabricate and qualify miniature isolation system for sensors and communications systems.
- (U)		Develop advanced spacecraft launch vibration isolation system.
- (U)	\$1,788	- (U) Fabricate and qualify the launch vibration isolation system to support first military EELV launch in FY 2001.
- (U)		Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

PROJECT

1026

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	1,058	987	2,544	Cost
	1,058	940	1,788	Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603218C, Research and Support.
- (U) PE 0603302F, Space and Missile Launch Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603401F Advanced Spacecraft Technology

PROJECT

2181

	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2181 Space Electronics and Software Technology		11,975	12,707	12,982	14,758	13,996	15,182	13,375	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project funds the demonstration and evaluation of electronic hardware and software. Improved space-qualifiable electronics and software for data and signal processing are to be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., hardening) commercial data and signal processor technologies for use in Air Force space systems. Advanced electronic packaging technologies that reduce weight and volume are being developed for military space applications. Space data processor technologies like the Advanced Technology Insertion Module (ATIM 32-bit) technology are developed and demonstrated. The Advanced Spaceborne Computer Module (ASCM), ATIM's 16-bit predecessor, is currently baselined into 65 DoD, National Aeronautics and Space Administration (NASA), and commercial programs. Also developed and demonstrated are space signal processor technologies like the Hardened Ada Signal Processor (HASP) program. For mid-term applications, the Improved Space Computer Program (ISCP) will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century DoD satellites. Low-cost, easily modifiable software and hardware architectures for ground control, satellite components, and autonomous satellite operations are also developed. The Multi-mission Advanced Ground Intelligent Control (MAGIC) program in this project has developed a low-cost, flexible architecture for satellite control and mission operations. In the long-term, this project area focuses on developing an integrated avionics-like architecture for satellites where high-speed data busses centralize many of the functions now distributed on the spacecraft. Additionally, this project demonstrates very low-power electronics allowing dramatic size, weight, and power reductions for future Air Force Space applications.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	2181	
(U) FY 1997 (\$ in Thousands):			
- (U)	\$6,722	Developed space-qualifiable, advanced low-power, hardened data processors and memory technologies.	
- (U)		- (U) Fabricated space-qualifiable 32-bit processor-based computers and demonstrated the full range of performance capabilities.	
- (U)	\$1,242	- (U) Designed an advanced, high throughput, low-power data processor based on commercial technology.	
- (U)		Developed space-qualifiable, hardened signal processor electronics technologies.	
- (U)	\$1,337	- (U) Fabricated silicon on insulator (SOI) version of space-qualifiable digital signal processor.	
- (U)		- (U) Evaluated the ability of both bulk silicon and SOI versions of the digital signal processor to perform in the space environment.	
- (U)		Developed space-qualifiable, advanced, mixed-signal electronics packaging technology such as three-dimensional (3-D) wafer scale integration.	
- (U)	\$2,483	- (U) Began demonstration of integrated sensor processing 3-D electronics assembly in robust space-qualifiable configuration.	
- (U)		- (U) Began demonstration of improved multi-chip module technology by constructing a complex multi-processor system.	
- (U)		Developed reusable, standardized satellite operations software.	
- (U)		- (U) Continued enhancing multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expanded software to include independent decision making capability.	
- (U)		- (U) Continued development of technologies for artificial intelligence assisted satellite operator systems.	
- (U)	\$191	- (U) Continued software support of the satellite command and control system upgrade.	
- (U)		Designed and developed space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques.	
- (U)		- Evaluated the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.	
- (U)	\$11,975	- Designed advanced experimental MEMS devices and demonstrated their performance in a space environment.	
- (U)		Total	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

2181

(U) FY 1998 (\$ in Thousands):

- (U) \$8,611 Develop affordable, space-qualifiable, low-power, high performance microelectronic technologies (processors, memories, gate arrays, etc.).
- (U) Complete space-qualifiable 32-bit processor-based components and demonstrate the full range of performance capabilities.
- (U) Continue design of an advanced, high throughput, low-power data processor based on commercial technology.
- (U) Complete design of silicon-on-insulator (SOI) version of the space-qualifiable digital signal processor.
- (U) Complete evaluation of the ability of both bulk silicon and SOI versions of the digital signal processor to perform in the space environment.
- (U) \$1,142 Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices.
- (U) Continue developing integrated three-dimensional (3-D) sensor processing electronics in robust space-qualifiable configuration.
- (U) Continue improving multi-chip module technology by constructing a complex multi-processor system; evaluate in space environment.
- (U) \$2,643 Develop reusable, standardized satellite operations software.
- (U) Complete enhancements for multi-mission advanced ground intelligent control software to provide operator assistance with unknown anomaly resolution and expansion of software to include independent decision making capability.
- (U) Complete development of artificial intelligence assisted satellite operator systems.
- (U) Initiate development of integrated applications for modeling and simulation technologies.
- (U) Continue software support of the satellite command and control system upgrade; initiate software engineering effort for space-based autonomous operations.
- (U) \$311 Design and develop space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques.
- (U) Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.
- (U) Complete design advanced experimental MEMS devices and demonstrate their performance in a space environment.
- (U) Continue fabrication of solid state micro-mechanical guidance instruments.
- (U) \$12,707 Total

Project 2181

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

2181

(U) FY 1999 (\$ in Thousands):

- (U) \$8,660 Develop affordable, space-qualifiable, low-power, high performance microelectronic technologies (processors, memories, gate arrays, etc.).
- (U) Continue design of an advanced, high throughput, low-power data processor based on commercial technology.
- (U) Develop integrated space computer version of advanced digital signal processor to perform in the space environment.
- (U) Initiate development of advanced next-generation digital signal processing technology and scalable multi-processor arrays.
- (U) Develop space-qualifiable high-performance electronics that provide maximum flexibility to space system designers (e.g., high-gate-count field programmable gate arrays).
- (U) \$1,147 Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices.
- (U) Continue integrated three-dimensional (3-D) sensor processing electronics assembly in robust space-qualifiable configuration.
- (U) Continue improving multi-chip module technology by constructing a complex multi-processor system; evaluate in space environment.
- (U) \$2,223 Develop reusable, standardized satellite operations software.
- (U) Continue to integrate and test space-based autonomous satellite operations software system technologies.
- (U) Continue development of integrated applications for modeling and simulation technologies.
- (U) Continue software support of the satellite command and control system upgrade.
- (U) \$39 Design and develop space-qualifiable silicon components using advanced micro-electro-mechanical systems (MEMS) techniques.
- (U) Continue to evaluate the compatibility of fabrication and packaging processes for highly integrated MEMS/electronics components able to operate in the space environment.
- (U) Complete design of advanced experimental MEMS devices and demonstrate their performance in a space environment.
- (U) \$913 Develop real-time space simulation for training and Concept of Operations (CONOPs).
- (U) Enhance simulation architecture for real-time and variable fidelity operations.
- (U) Continue development of advanced bus health and status models for autonomous operations.
- (U) Upgrade fidelity of surveillance payload models.
- (U) \$12,982 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	2181	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	11,975	13,632	13,036
	11,975	12,707	12,982
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0303601F, MILSTAR Satellite Communications System.			
- (U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).			
- (U) PE 0602601F, Phillips Laboratory.			
- (U) PE 0603311F, Ballistic Missile Technology.			
- (U) PE 0603215C, Limited Defense System.			
- (U) PE 0603218C, Research and Support.			
- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.			
- (U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603401F Advanced Spacecraft Technology

PROJECT

3784

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3784 Space Sensors and Satellite Communication Technology		2,177	2,710	1,760	3,556	4,273	3,865	3,930	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project funds the development of military space-based ground surveillance and satellite communication technologies. The project's work focuses on advancing space-based applications of commercial sensors and communication technologies while improving the performance, schedule, maturity, cost, and/or risk reduction. The focus of the space sensor effort is to meet spaceborne sensor needs for national missile defense and intelligence, surveillance, and reconnaissance missions. The focus of the satellite communications effort is to develop radio frequency (RF) technologies for future military, intra-space, and space-ground communication systems. This project seeks to improve affordability, reliability, and performance while significantly reducing space sensor and satellite communication size, weight, cost, and cooling and power requirements.

## (U) FY 1997 (\$ in Thousands):

- (U) \$1,007 Developed space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.
- (U) Investigated state-of-the-art techniques for raising the operating temperature (120K or higher) of mid-wave infrared detectors.
- (U) Initiated investigation of technologies for scaling mercury cadmium telluride (HgCdTe) focal plane arrays to 1024 by 1024 array size.
- (U) \$650 Developed space-based radar technology investment plans.
  - (U) Began development and evaluation of potential antenna architectures.
  - (U) Continued assessment of operational utility of candidate space-based surveillance technologies.
- (U) \$258 Developed simulation models for Space-Based Radar (SBR) system.
  - (U) Assessed potential distributed interactive simulation compatible models for application to SBR scenarios.
  - (U) Initiated development of distributed interactive simulation models for SBR.
- (U) \$262 Developed satellite communication technology which supports space communications needs.
  - (U) Completed assessment of commercial communication technology for transition to military systems.
- (U) \$2,177 Total

Project 3784

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	3784	
(U) FY 1998 (\$ in Thousands):			
- (U)	\$1,515	Develop space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.	
- (U)		- (U) Initiate design and development effort for mid-wave infrared detectors with higher operating temperatures (120 to 140K).	
- (U)		- (U) Complete investigation of scaling technologies for mercury cadmium telluride focal plane arrays.	
- (U)	\$904	- (U) Investigate efforts to increase yield and reliability of large format infrared focal plane arrays.	
- (U)		Develop space-based radar technology investment plans.	
- (U)		- (U) Continue development and evaluation of potential antenna architectures and radar concepts.	
- (U)		- (U) Continue to assess the operational utility of candidate space-based surveillance technologies.	
- (U)	\$291	- (U) Begin development of testbed for Space-Based Radar (SBR) system integration and operational evaluation.	
- (U)		Develop simulation models for SBR system.	
- (U)	\$2,710	- Continued development of distributed interactive simulation models for SBR.	
- (U)		Total	
(U) FY 1999 (\$ in Thousands):			
- (U)	\$300	Develop space-based reconnaissance/surveillance sensor technology to meet high priority Air Force needs.	
- (U)		- (U) Complete fabrication of short-wave and mid-wave focal plane infrared detectors with higher operating temperatures (120 to 140K).	
- (U)		- (U) Evaluate and provide design recommendations on the short-wave and mid-wave focal plane infrared detectors with higher operating temperatures (120 to 140K).	
- (U)	\$970	Develop space-based radar technology investment plans.	
- (U)		- (U) Complete development and evaluation of potential antenna architectures and radar concepts.	
- (U)		- (U) Continue to assess the operational utility of candidate space-based surveillance technologies.	
- (U)	\$490	- (U) Continue development of testbed for SBR system integration and operational evaluation.	
- (U)		Develop simulation models for SBR system.	
- (U)	\$1,760	- Complete development of distributed interactive simulation models for SBR.	
- (U)		Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	3784																
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="0"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>2,423</td> <td>2,848</td> <td>3,295</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>2,177</td> <td>2,710</td> <td>1,760</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0303601F, MILSTAR Satellite Communications System.</li> <li>- (U) PE 0602601F, Phillips Laboratory.</li> <li>- (U) PE 0602702F, Command/Control/Communication Technology.</li> <li>- (U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.</li> <li>- (U) PE 0604711F, Extremely High Frequency Satellite Communications Research and Development.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	2,423	2,848	3,295	Cost	(U) Current Budget Submit/FY 1999 PB	2,177	2,710	1,760	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	2,423	2,848	3,295	Cost														
(U) Current Budget Submit/FY 1999 PB	2,177	2,710	1,760	Cont														

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603401F Advanced Spacecraft Technology								3834	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3834 Integrated Space Technology Demonstrations		37,847	17,739	20,447	18,255	19,034	20,780	21,867	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification</u>: The Integrated Space Technology Demonstration (ISTD) program is a series of demonstrations, or projects established to address the latest Air Force Space Command (AFSPC) Mission Area Plan (MAP) deficiencies. The ISTD program provides for the integration of government and commercially developed technologies onto satellites. The ISTD seeks to validate and demonstrate the value of these new technologies to address new space tactics, techniques, procedures, doctrine, and possibly revolutionize future acquisitions of DoD space systems. The ISTD program will enhance commercial and civil space assets in a cost-effective manner, allowing the warfighter to assess the utility of new space technologies through leveraging opportunities and, when required, through dedicated space flight demonstrations.</p> <p>The highly successful Technology for Autonomous Operational Survivability (TAOS) satellite was the first of the ISTD series. TAOS was launched in March 1994 and is currently demonstrating advanced warfighter concepts and the viability of advanced computers, autonomous navigation hardware/software, laser sensors, radar sensors, and data buses in space. TAOS has allowed operators and users, for the first time, to directly conduct space exercises in conjunction with the Air Force Research Laboratory (AFRL). External customer funding will be used in FY1998 and out to continue TAOS operations until the satellite ceases to function.</p> <p>In FY 1995, the ISTD program office initiated a cooperative agreement with National Aeronautics and Space Administration's (NASA) Small Spacecraft Technology Initiative (SSTI) program to leverage the NASA Clark satellite with Air Force funding and technologies. AFRL and NASA agreed to integrate an S-band transmitter on Clark to allow command and control of the satellite along with reception of imaging payload data from a mobile ground station controlled by the warfighter. Clark is set for launch in February 1998. In general, the ISTD series of space technology demonstrations will allow users to assess new space technologies, which, when integrated, will become technology options for future space systems. The Warfighter (WF-1) contract started in August to develop the capability of using hyperspectral imaging from space to detect tactical targets and perform battlefield characterization.</p>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

3834

## (U) FY 1997 (\$ in Thousands):

- (U)	\$1,513	Completed the Technology for Autonomous Operational Survivability (TAOS) flight demonstration.
- (U)		Completed TAOS final report.
- (U)		Extended TAOS close-out to December 1997 to allow time to start a new contract for on-orbit mission continuation. All FY 1998 operations will be customer funded.
- (U)	\$471	Prepared for joint Air Force/ National Aeronautics and Space Administration (NASA) on-orbit technology assessments and data collection of the Clark spacecraft.
- (U)	\$10,966	Conducted Integrated Space Technology Demonstration (ISTD) series program.
- (U)		Awarded contract for the ISTD Warfighter-1 hyperspectral technology demonstration project.
- (U)		Began design of Warfighter-1 payload and mobile ground station.
- (U)		Began procurement of long-lead items for payload and mobile ground station requirements.
- (U)		Began development and modification of algorithms for Warfighter-1 satellite payload and ground station.
- (U)	\$ 1,006	Developed simulation applications for integrated satellite payloads, mission utility, and system engineering.
- (U)	\$23,891	Delivered real-time surveillance payload simulations.
- (U)		Developed and demonstrated miniaturized space technologies.
- (U)		Selected a mission and developed component technologies for the Clementine 2 microsatellite technology development.
- (U)		Continued development and integration of spacecraft subsystems, bus system design, bi-propellant system, and non-toxic propulsion system for the Clementine 2 spacecraft.
- (U)	\$37,847	Total

## (U) FY 1998 (\$ in Thousands):

- (U)	\$378	Perform joint Air Force/NASA on-orbit technology assessments and data collection of the Clark spacecraft.
- (U)	\$16,455	Conduct ISTD series program.
- (U)		Continue design and begin fabrication of Warfighter-1 payload and mobile ground station.
- (U)		Continue procurement of long lead items for payload and mobile ground station requirements.
- (U)		Continue development and modification of algorithms for Warfighter-1 satellite payload and ground station.
- (U)		Start initial planning for suite of technologies to be demonstrated in Warfighter-2.
- (U)	\$906	Develop simulation applications for integrated satellite payloads, mission utility, and system engineering.
- (U)	\$17,739	Continue development of advanced surveillance payload simulations.
- (U)		Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603401F Advanced Spacecraft Technology</b>		<b>3834</b>
(U) FY 1999 (\$ in Thousands):			
- (U)	\$100	Complete joint Air Force/National Aeronautics and Space Administration (NASA) on-orbit technology assessments and data collection of the Clark spacecraft, close out mission, and develop final report on technology and military utility assessment.	
- (U)	\$19,072	Conduct Integrated Space Technology Demonstration (ISTD) series program.	
		- (U) Complete design, fabrication, and integration of Warfighter-1 payload and mobile ground station.	
		- (U) Perform integration and test of Warfighter-1 payload to Orbview 3 spacecraft.	
		- (U) Ship space vehicle to launch site and begin integration of Warfighter-1/Orbview 3 space vehicle to launch vehicle.	
		- (U) Continue development and modification of algorithms for Warfighter-1 satellite payload and ground station.	
		- (U) Perform suite of technologies demonstrated in Warfighter-2.	
- (U)	\$490	Develop advanced boost guidance technology to reduce current operations costs and improve reliability and maintainability of existing systems and develop precision navigation systems for future intercontinental ballistic missiles (ICBM) delivered conventional munitions.	
		- (U) Develop, integrate, and test Global Positioning System/Inertial Navigation System (GPS/INS) in plasma and jamming environments for precision ICBM navigation.	
- (U)	\$785	Develop advanced navigation technology to support range instrumentation and improve safety requirements.	
		- (U) Develop, integrate, and test GPS-based navigation packages coupled directly with INS that survive and reacquire after the plasma blackout during reentry, and improve the accuracy, range, and safety of ballistic missiles.	
- (U)	\$20,447	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998																				
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																					
<b>3 - Advanced Technology Development</b>	<b>0603401F Advanced Spacecraft Technology</b>	<b>3834</b>																					
<p>(U) <b>B. <u>Program Change Summary (\$ in Thousands):</u></b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>37,847</td> <td>18,788</td> <td>20,358</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>37,847</td> <td>17,739</td> <td>20,447</td> <td>Cont</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation: Funding: Changes to this project since the previous President's Budget are due to priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable. Technical: Not Applicable.</p> <p>(U) <b>C. <u>Other Program Funding Summary:</u></b></p> <p>(U) Related Activities:          - (U) PE 0602601F, Phillips Laboratory.          - (U) PE 0603605F, Advanced Weapons Technology.          - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) <b>D. <u>Schedule Profile:</u></b> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	37,847	18,788	20,358	Cost	(U) Current Budget Submit/FY 1999 PB	37,847	17,739	20,447	Cont					Cont
	FY 1997	FY 1998	FY 1999	Total																			
(U) Previous President's Budget (FY 1998 PB)	37,847	18,788	20,358	Cost																			
(U) Current Budget Submit/FY 1999 PB	37,847	17,739	20,447	Cont																			
				Cont																			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE		February 1998	
BUDGET ACTIVITY					PE NUMBER AND TITLE					PROJECT			
3 - Advanced Technology Development					0603401F Advanced Spacecraft Technology					4400			
COST (\$ In Thousands)					FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4400 Satellite Survivability Technology					5,734	5,310	826	1,294	2,021	3,271	3,514	Continuing	Continuing
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> This project funds the development and demonstration of technologies required to assure operation of U.S. space assets in potentially hostile warfighting environments. Work performed includes assessment of critical components, subsystems, and systems' threat susceptibility and vulnerability. This project also develops technologies to mitigate identified vulnerabilities. Further, technology options are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment. Efforts under this project will be closely integrated with exploratory space technologies such as those developed under PE 0602601F, Project 8809, and advanced space technologies developed under this PE in Projects 1026, 2181, 3784, and 682J. Where appropriate, end products include integrated demonstrations with technologies developed in Project 3834. Through this project, the Air Force assumes responsibility for critical spacecraft survivability technology from the Ballistic Missile Defense Organization (BMDO). Note: Congressional funds for the Miniaturized Satellite Threat Reporting System (MSTRS) were provided in FY 1997 (\$2 million) and in FY 1998 (\$5 million).</p>													
<p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"><li>- (U) \$1,261 Assessed selected directed energy weapon threat environment susceptibility/vulnerability of critical space-based sensor and communications subsystems.</li><li>- (U) Performed an assessment of laser and radio frequency (RF) weapon susceptibilities for spacecraft subsystems including mission optical sensors and communications payloads.</li><li>- (U) Performed an experimental assessment of a Charge Coupled Device (CCD) sensor's susceptibility to RF illumination.</li><li>- (U) Initiated development of a multi-threat sensor performance modeling tool.</li><li>- Performed RF threat warning space-based sensor design, fabrication, and test.</li><li>- (U) Integrated radar warning and intrusion/interference detector concepts.</li><li>- (U) Completed antenna and snapshot recorder designs; initiated software design for digital receiver.</li><li>- (U) Initiated fabrication of prototype antenna design.</li><li>- Augmented baseline Threat Warning/Attack Reporting (TW/AR) by adding a broad-band Radar Warning Receiver for MSTRS.</li><li>- (U) Completed preliminary design of RF front end and digital electronics for space experiment.</li><li>- (U) Initiated fabrication of hardware including the microwave assembly, successive detection logarithmic amplifier, and microwave receiver.</li><li>- (U) Selected, for evaluation, laser weapon detection technologies for satellites in hostile environments.</li><li>- (U) Completed TW/AR laser threat assessment and laser detection trade study.</li><li>- (U) Initiated laser detector fabrication and functional test.</li><li>- (U) Total</li></ul>													

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

4400

## (U) FY 1998 (\$ in Thousands):

- (U)	\$182	Continue susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
- (U)	\$182	- (U) Update susceptibility/vulnerability assessments of hostile/stressing ambient/enhanced space environment on subsystem performance.
- (U)	\$187	Refine directed energy multi-threat sensor performance modeling tool.
- (U)	\$1,428	Evaluate protection implications of selected advanced spacecraft technologies.
- (U)		Design integrated Monolithic Microwave Integrated Circuit (MMIC) microwave pre-selector assembly and four multi-chip modules for a miniaturized satellite threat warning and attack reporting system.
- (U)	\$2,855	Fabricate and test integrated MMIC assembly and multi-chip modules for the miniaturized satellite threat warning and attack reporting system.
- (U)	\$476	Investigate composite materials and advanced packaging concepts for a miniaturized satellite threat warning and attack reporting system.
- (U)	\$5,310	Total

## (U) FY 1999 (\$ in Thousands):

- (U)	\$43	Continue susceptibility/vulnerability assessments of critical space-based subsystems to ambient/enhanced space environments and directed energy weapon threats.
- (U)	\$490	- (U) Assess hostile/stressing environment impact on subsystem performance parameters using multithreat sensor modeling tool.
- (U)	\$293	Perform radio frequency (RF) threat warning space-based sensor design, fabrication, and test.
- (U)		- (U) Complete fabrication and test of RF payload for space experiment
- (U)		Select, for evaluation, laser weapon detector technologies for satellites in hostile environments.
- (U)	\$826	- (U) Complete fabrication and test of laser detector brassboard.
- (U)		Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603401F Advanced Spacecraft Technology</b>	<b>4400</b>	
(U) <u>B. Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	5,778	592	582
	5,734	5,310	826
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes in this project since the previous President's Budget are due to priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) <u>C. Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0602102F, Materials.			
- (U) PE 0602601F, Phillips Laboratory.			
- (U) PE 0603410F, Space Systems Environmental Interactions Technology.			
- (U) PE 0603605F, Advanced Weapons Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) <u>D. Schedule Profile:</u> Not Applicable.			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

PROJECT

4599

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4599 Reusable Launch Vehicle Technology		9,579	11,715	0	0	0	0	0	TBD	TBD

**(U) A. Mission Description and Budget Item Justification:** This project funds development of technologies for advanced and innovative low-cost launch vehicles and orbit transfer vehicles. This Air Force Reusable Launch Vehicle (RLV) technology project directly complements and leverages off of the National Aeronautics and Space Administration (NASA)-led RLV program. The spending plan has also been coordinated and approved by NASA Headquarters. The tasks identified in this project summary represent the DoD stake in RLV technology development as recommended by the Space Launch Modernization Plan (SLMP) study. In FY 1998, Congress added \$5M for low-cost launch vehicle technology development and \$7.5M for the Solar Thermionic Orbit Transfer Vehicle (SOTV) to this project.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$6,705 Applied advanced military unique technologies to reusable launch vehicles.
- (U) \$958 Began development of an integrated technology testbed to coordinate technology development. Performed technology development for upperstages as they apply to reusable launch vehicles.
- (U) \$1,916 Continued development of concepts and military unique technologies for use in an upperstage. Executed and coordinated the Department of Defense reusable launch vehicle program including coordination with NASA's X-33 program and analysis of military applications.
- (U) \$9,579 Total

**(U) FY 1998 (\$ in Thousands):**

- (U) \$1,406 Develop low-cost, reliable, launch vehicle technologies.
- (U) Continue systems engineering effort for the SR-2 testbed vehicle.
- (U) Build and conduct ground demonstration of Hydroxyl Amine Nitrate - Tri-Ethanol Amine Nitrate (HAN TEAN) flight weight gas generator.
- (U) Build and conduct ground demonstration of POD separation devices.
- (U) Design, fabricate, and test five foot linerless poly Dicyclopentadiene (DCPD) resin liquid oxygen tank
- (U) \$3,280 Conduct suborbital flight tests of low-cost launch technologies.
- (U) Perform series of flight tests and evaluate performance of the SR-1 low-cost launch technology testbed vehicle.
- (U) Reengineer SR-1 testbed vehicle, incorporating "lessons learned" from initial flight test experience.

Project 4599

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>	PROJECT <b>4599</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603401F Advanced Spacecraft Technology</b>		

  

- (U)	\$7,029	Develop technologies for upperstages that can operate as orbit transfer vehicles.
-	(U)	Continue development of radiation hardened thermionic energy conversion device.
-	(U)	Continue development of rigid deployable solar concentrator technology.
-	(U)	Continue development of lightweight cryogenic propellant storage tank.
-	(U)	Continue development of high-power electric energy generation subsystem.
-	(U)	Continue development of high specific impulse orbit transfer propulsion system.
- (U)	\$11,715	Total

  

(U) FY 1999: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT
3 - Advanced Technology Development	0603401F Advanced Spacecraft Technology		4599
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 1998 PB)	9,579	0	0
(U) Current Budget Submit/FY 1999 PB	9,579	11,715	0
			Total
			Cost
			TBD
			TBD
(U) Change Summary Explanation:			
Funding: Congress added \$10 million in FY 1997 for Reusable Launch Vehicle technology. In FY 1998, Congress added \$5 million for low-cost launch vehicle technology and \$7.5 million for the Solar Thermionic Orbit Transfer Vehicle.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0602102F, Materials.			
- (U) PE 0602269F, Hypersonic Technology Program.			
- (U) PE 0602601F, Phillips Laboratory.			
- (U) PE 0603302F, Space and Missile Launch Technology.			
- (U) PE 0603853F, Evolved Expendable Launch Vehicle Program.			
- (U) UPN 242, National Aeronautics and Space Administration (NASA) Reusable Launch Vehicle Program.			
- (U) This project has been coordinated through the Reliance process and with NASA to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998					
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT					
3 - Advanced Technology Development		0603401F Advanced Spacecraft Technology		682J					
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
682J Space Power and Thermal Management Technology	4,555	3,778	4,768	5,961	7,700	7,366	7,524	Continuing	Continuing
<p><b>(U) A. Mission Description and Budget Item Justification:</b> This project develops and demonstrates compact, low-cost, spacecraft and ballistic missile power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation work focuses on lightweight, low-cost, low volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydride (NiH<sub>2</sub>) and sodium sulfur (NaS) spacecraft batteries and flywheel energy storage systems for extended (five-ten year) satellite missions. Power distribution efforts focus on producing lightweight, high efficiency, standardized power busses for use on future Air Force space programs. This project also funds the development and demonstration of the non-nuclear technologies associated with space nuclear power systems such as power conversion, conditioning, and power system thermal management. In addition, investigations into alternative technologies to increase space vehicle power subsystem performance, lifetime, survivability, and safety while reducing costs/risks. In FY 1995, the Air Force assumed responsibility for the Ballistic Missile Defense Organization's (BMDO's) goal to develop spacecraft thermal management technologies. Examples of this are cryogenic coolers necessary to maintain passive (e.g., infrared focal plane array) sensors in low-light backgrounds through this project.</p>									

Project 682J

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603401F Advanced Spacecraft Technology

682J

(U) FY 1997 (\$ in Thousands):

- (U)	\$2,850	Developed space conventional power technologies such as advanced solar cells and arrays.
- (U)		Demonstrated high voltage (45-130V) space-qualified 90% efficient power converters and 99% efficient solid state switches for power management and distribution system applications.
- (U)		Continued development of 25% efficient alkali metal thermal to electric converter (AMTEC) cells.
- (U)		Conducted life cycle testing of AMTEC cells.
- (U)		Demonstrated more manufacturable 25% efficient space-qualified three-junction solar cell.
- (U)		Designed and fabricated thermionic testbed power system components for evaluation.
- (U)		Initiated multi-junction solar cell flight test program.
- (U)	\$1,330	Developed space vehicle conventional power technologies such as compact volume/weight batteries.
- (U)		Continued NiH <sub>2</sub> low earth orbit life testing.
- (U)		Completed fabrication of Sodium Sulfur Battery Cell Flight Experiment for manifest on shuttle flight Space Transportation System 87 (STS-87) mission to be flown in November 1997.
- (U)	\$375	Developed space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
- (U)	\$4,555	Quantified single stage reverse Brayton cryocooler performance parameters and generated requirements for a 10K cryogenic cooler.
- (U)		Total

(U) FY 1998 (\$ in Thousands):

- (U)	\$2,494	Develop space conventional power technologies such as advanced solar cells and arrays.
- (U)		Continue development of 25% efficient alkali metal thermal to electric converter (AMTEC) cells.
- (U)		Complete technology transition of more manufacturable efficient space-qualified three-junction solar cell program.
- (U)		Continue multi-junction solar cell flight test program.
- (U)		Continue electrical characterization of three- and four-junction solar cells.
- (U)	\$331	Develop space vehicle conventional power technologies such as compact volume/weight batteries.
- (U)		Continue Nickel Hydride battery low earth orbit life testing.
- (U)		Complete demonstration of Sodium Sulfur Battery Cell with flight experiment on Space Transportation System 87 (STS-87).
- (U)	\$953	Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
- (U)	\$3,778	Initiate preliminary design, critical design, and development of a prototype 10K cryogenic cooler for space application.
- (U)		Total

Project 682J

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**3 - Advanced Technology Development**

(U) FY 1999 (\$ in Thousands):

0603401F Advanced Spacecraft Technology

PROJECT

682J

(U)	FY 1999 (\$ in Thousands):	
- (U)	\$2,827	Develop space conventional power technologies such as advanced solar cells and arrays.
- (U)		Initiate advanced lightweight, high efficiency, radiation resistant concentrator solar array program.
- (U)		Initiate alkali metal thermal to electric converter (AMTEC) cell flight demonstration program.
- (U)		Continue multi-junction solar cell flight test program.
- (U)		Continue electrical characterization of three- and four-junction solar cells.
- (U)	\$814	Develop space vehicle conventional power technologies such as compact volume/weight batteries.
- (U)		Complete ten year NiH <sub>2</sub> low earth orbit life testing.
- (U)		Continue development of lightweight flywheel integrated power and attitude control systems (IPACS); initiate cooperative IPACS experiment on International Space Station scheduled for deployment in FY 2001.
- (U)	\$1,127	Develop space vehicle thermal management technology such as cryogenic coolers for infrared focal plane arrays.
- (U)	\$4,768	Fabricate and begin characterization of 10K cryogenic cooler for very long wavelength infrared space applications.
- (U)		Total

Project 682J

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE \_\_\_\_\_

February 1998

### BUDGET ACTIVITY

PE NUMBER AND TITLE

## PROJECT

### 3 - Advanced Technology Development

**0603401F Advanced Spacecraft Technology**

682J

(U) **B. Program Change Summary (\$ in Thousands):**

Total

Cost

FY 1999

FY 1998

FY 1997

4,864

3,999

4,555

**Cont**

4,768

3,778

4,555

(U) Change Summary Explanation:

**Funding:** Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

**Schedule: Not Applicable.**

**Technical: Not Applicable.**

**(U) C. Other Program Funding Summary:**

(U) Related Activities:

(U) PE 0602203F, Aerospace Propulsion.

(U) PE 0602601F, Phillips Laboratory.

(U) PE 0603302F, Space and Missile Launch Technology.

(U) PE 0603218C, Research and Support.

(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) **D. Schedule Profile:** Not Applicable.

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PE NUMBER: 0603410F

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PE TITLE: Space Systems Environmental Interactions Technology

<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603410F Space Systems Environmental Interactions Technology								2822	

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2822	Space Environmental Impact Tests	2,528	3,012	3,457	3,718	3,755	3,850	3,952	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: Beginning in FY 1998, Projects 2822, Space Environmental Impact Test, and 2823, Space Hazards Mitigation, were combined under Project 2822. For clarity, the funding for FY 1997 reflects this consolidation.

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program's objectives are to improve the survivability and reliability of current and future DoD space systems, expedite the transfer of new technologies into military weapon systems hardware, and develop and demonstrate cost-effective solutions to mitigate hazardous space-environmental interactions that degrade spacecraft operations. Advanced technology goals include: (1) development of an autonomous active charge control system to prevent charge buildup on high-altitude spacecraft; (2) development of a compact environmental anomaly sensor to provide real-time warning to satellites of space-environmental conditions likely to cause anomalous operations; (3) improved specifications for use of advanced microelectronic components and solar array technologies in the space radiation environment; and (4) demonstration in space of small, low power, high performance space environmental sensors with potential application aboard current and future operational spacecraft. These goals will be achieved through (1) analysis of data from current and past experiments such as the Charge Control System (demonstrates active mitigation of spacecraft charging hazards), the Charging Hazards and Wake Studies experiment (determined space environmental hazards to exposed high voltages), the Shuttle Potential and Return Electrons Experiment (investigated the effect of high current electron beams on the ambient space environment), the Space Waves in Plasmas Experiment (looked at space effects on high-frequency radio transmissions), and the Photovoltaic Array Space Power Plus Diagnostics experiment (assessed performance and high voltage interactions of select solar array technologies in the radiation environment); and (2) space flight of new experiments to extend these results and investigate areas of concern, including the Digital Ion Drift Meter experiment (will demonstrate the use of miniaturized components, an advanced compact design, and digital techniques for monitoring low energy charged particles in space), the Small On-Board Environmental Diagnostic Sensors experiment (will demonstrate a suite of miniaturized components for monitoring high energy charged particles in space), and radiation and high voltage interactions experiments (to assess the performance of advanced microelectronic components and solar array technologies under adverse space environmental conditions and demonstrate techniques for mitigating or eliminating the effects of these interactions).

Project 2822

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Exhibit R-2 (PE 0603410F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology	February 1998	2822
<p>(U) FY 1997 (\$ in Thousands):</p> <ul style="list-style-type: none"> <li>- (U) \$1,615 Developed and tested miniaturized, low-power, high performance space sensors to measure hazardous charged particles responsible for long-term radiation dose effects, excess charge buildups, single event upsets, and degradation of DoD spacecraft systems.</li> <li>- (U) Completed data analysis from Charging Hazards and Wake Studies experiment and transitioned results to DoD space system designers. Data was used to improve low-earth environmental specifications and to validate charge analysis modeling codes.</li> <li>- (U) Delivered the first Digital Ion Drift Meter space plasma sensor (designed for use on the National Polar-orbiting Operational Environmental Satellite System and Comm/Nav Outage Forecast System) to the Space Test Program Office for integration on the STEP-4 spacecraft to space qualify this sensor for operational use.</li> <li>- (U) Began design of an upgraded Digital Ion Drift Meter for flight on the German CHALLENGING Microsatellite Project (CHAMP) geophysical satellite in 1999. This second qualification flight will exercise an instrument incorporating many design improvements with substantially increased capabilities. A production version of this instrument will provide near real-time space environmental information to DoD space weather forecasters for predicting conditions affecting spacecraft operations.</li> <li>- (U) Completed design and began fabrication of miniaturized, low-power electron and proton telescopes to monitor the space radiation environment aboard future DoD spacecraft.</li> <li>- (U) \$133 Demonstrated performance of next-generation solar array technologies in space before integrating them into future space systems. Characterize component interactions with natural environment.</li> <li>- (U) Completed analysis of Photovoltaic Array Space Power Plus Diagnostics data, and transitioned to DoD spacecraft designers technical specifications on high-voltage plasma interactions and advanced solar array radiation degradation for updating space power design guidelines and test standards.</li> <li>- (U) \$321 Determined vehicle charging and environmental interactions which will result in improved preventive measures to protect spacecraft from charging hazards. Developed enhanced analytical models of vehicle charging and spacecraft environmental interactions directly applicable to future high-powered space systems.</li> <li>- (U) Transitioned technology to DoD spacecraft designers to improve modeling codes for vehicle charging effects and environmental interactions.</li> <li>- (U) \$137 Determined the interactions between spacecraft and their environment that limit performance of long-range, high frequency communications and radar systems.</li> <li>- (U) Provided results of sounding rocket tests to DoD communication system designers for incorporation into design and performance standards used to counter scintillation (communications signal degradation) effects.</li> </ul>			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology		2822
- (U)	\$322	Developed and tested technologies to monitor and mitigate hazardous space environmental interactions. Demonstrated an autonomous, active charge control system to prevent hazardous charge buildup on high-altitude and geosynchronous orbit satellites to decrease circuitry upsets and component damage, and improve on-orbit reliability and performance. Demonstrate an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite and warn of hazardous conditions.	
- (U)	\$2,528	<ul style="list-style-type: none"> <li>- (U) Evaluated the data from the Defense Satellite Communications System flight, and obtained approval from the Program Office to continue operations for additional performance analysis.</li> <li>- (U) Completed fabrication and began testing of the Compact Environmental Anomaly Sensor that will be space qualified on the Space Test Program's TSX-5 satellite.</li> </ul>	
- (U)	Total		
(U) FY 1998 (\$ in Thousands):			
- (U)	\$2,500	Develop and test miniaturized, low-power, high performance space sensors to measure the hazardous charged particles responsible for long-term radiation dose effects, excess charge buildups, single event upsets, and degradation of DoD spacecraft systems.	
- (U)	\$181	<ul style="list-style-type: none"> <li>- (U) Support launch, on-orbit operations, and performance analysis of the Digital Ion Drift Meter space plasma sensor on the Space Test Program's STEP-4 satellite. This space flight is the first of two to obtain space qualification of this sensor needed for operational use.</li> <li>- (U) Fabricate, test, and integrate an upgraded Digital Ion Drift Meter for a 1999 flight on the German CHALLENGING Microsatellite Project (CHAMP) geophysical satellite. This will be the second qualification flight, with DIDM being in a more operationally realistic orbit.</li> <li>- (U) Fabricate miniaturized, low-power, proton and electron telescopes to monitor the space radiation environment aboard future DoD spacecraft.</li> </ul>	
- (U)		Demonstrate performance of next-generation solar array and microelectronic component technologies in space before integrating them into future space systems. Characterize component interactions with natural environment. Demonstrate active and passive techniques for reducing or eliminating these effects on the system.	
- (U)		<ul style="list-style-type: none"> <li>- (U) Design spacecraft payload to test advanced solar array and microelectronic components susceptibility to total radiation dose, single event upsets, and charging induced interactions with the environment. Experiment results over a wide range of space environmental conditions will be used to develop improved design and performance specifications, so DoD spacecraft designers can develop more reliable and survivable systems.</li> </ul>	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology	2822	
- (U)	\$331	Develop and test technologies to monitor and mitigate hazardous space environmental interactions. Demonstrate an autonomous, active charge control system to prevent hazardous charge buildup on high-altitude and geosynchronous orbit satellites, to decrease circuitry upsets and component damage, and improve on-orbit reliability and performance. Demonstrate an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite and warn of hazardous conditions.	
		- (U) Complete evaluation of the long-term performance on the Defense Satellite Communications System satellite and address operational utility and potential improvements for use aboard future operational spacecraft.	
		- (U) Support launch, on-orbit operations, and performance analysis of the Compact Environmental Anomaly Sensor hazard-warning instrument on the Space Test Program TSX-5 satellite.	
		- (U) Deliver two Compact Environmental Anomaly Sensors for flight on Spaced-Based Infrared Satellite (SBIRS) technology demonstrators. These sensors will be used to verify SBIRS radiation hardening.	
- (U)	\$3,012	Total	
(U) FY 1999 (\$ in Thousands):			
- (U)	\$2,247	Develop and test miniaturized, low-power, high performance space sensors to measure hazardous charged particles responsible for long-term radiation dose effects, excess charge buildups, single event upsets, degradation of DoD spacecraft systems.	
		- (U) Conduct on-orbit operations and performance analysis of the Digital Ion Drift Meter (DIDM) space plasma sensor on the Space Test Program's STEP-4 satellite to obtain the space qualification needed for operational use on national environmental monitoring satellites.	
		- (U) Support launch, on-orbit operations, and performance analysis of the upgraded Digital Ion Drift Meter on the German CHALLENGING Microsatellite Project (CHAMP) geophysical satellite. This will be the second qualification flight, with DIDM being in a more operationally realistic orbit.	
		- (U) Complete fabrication of miniaturized, low-power, electron and proton telescopes to monitor the space radiation environment aboard future DoD spacecraft.	
- (U)	\$864	Demonstrate performance of next-generation solar array and microelectronic component technologies in space before integrating them into future space systems. Characterize component interactions with natural environment. Demonstrate active and passive techniques for reducing or eliminating these effects on the system.	
		- (U) Begin fabrication of spacecraft payload to test advanced solar array and microelectronic components susceptibility to total radiation dose, single event upsets, and charging induced interactions with the environment.	
- (U)	\$346	Develop and test technologies to monitor and mitigate hazardous space environmental interactions. Demonstrate an autonomous, compact, lightweight, low-power instrument to monitor the space environment near a satellite and warn of hazardous conditions.	

Project 2822

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology	2822	
<ul style="list-style-type: none"><li>- (U) Conduct operations and performance analysis of the Compact Environmental Anomaly Sensor hazard-warning instrument on the Space Test Program's TSX-5 satellite.</li><li>- (U) Support launch, on-orbit operations, and performance analysis of the Compact Environmental Anomaly Sensor hazard-warning instrument on the United States/British Space Test Research Vehicle (STRV)-1C satellite. This second qualification flight will exercise instrument performance in a higher radiation environment than the flight on TSX-5.</li><li>- (U) Support launch and on-orbit operations of two Compact Environmental Anomaly Sensors on the Space-Based Infrared Satellite (SBIRS) technology demonstrators.</li></ul>			
- (U)	\$3,457	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603410F Space Systems Environmental Interactions Technology	February 1998	2822

  

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
				Cost
				Cont
(U) Previous President's Budget (FY 1998 PB)	2,793	3,151	3,527	
(U) Appropriated Value	2,914	3,151		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-62	-102		
b. SBIR	-59	-37		
c. Omnibus/Other Above Threshold Reprogrammings	-260			
d. Below Threshold Reprogrammings				
e. Rescissions	-5			
(U) Adjustments to Budget Year Since FY 1998 PB			-70	
(U) Current Budget Submit/FY 1999 PB	2,528	3,012	3,457	Cont

(U) Change Summary Explanation:  
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603601F

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PE TITLE: Conventional Weapons Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PE NUMBER AND TITLE	
3 - Advanced Technology Development										0603601F Conventional Weapons Technology	
COST (\$ In Thousands)											
Total Program Element (PE) Cost											
670A	Ordnance Technology		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
			25,279	21,622	23,244	23,983	23,848	24,189	24,607	Continuing	Continuing
670B	Guidance Technology		17,233	10,628	9,981	7,951	11,477	12,670	15,971	Continuing	Continuing
			8,046	10,994	13,263	16,032	12,371	11,519	8,636	Continuing	Continuing
	Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0
<p>Note: Beginning in FY 1998, technologies related to Global Positioning System (GPS) guidance (i.e., differential GPS and anti-jam technologies) and highly agile missile flight control will be developed in Project 670B, Guidance Technology, rather than in Project 670A.</p> <p>(U) A. <b>Mission Description and Budget Item Justification:</b> This Advanced Technology Development program develops and demonstrates conventional weapons technologies including guidance, ordnance, and aeromechanics. This program develops the following technologies: autonomous, adverse-weather advanced guidance seekers; fuzes; explosives; hard target warheads; bombs, submunitions, and their dispensing mechanisms; weapon airframes; and weapon technology integration for conventional weapons. Hardware/software are developed and evaluated to determine effectiveness and potential operational value.</p>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603601F Conventional Weapons Technology

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	23,754	26,227	23,712	
(U) Appropriated Value	24,885	24,687		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-588	-1,072		
b. SBIR	-543	-493		
c. Omnibus/Other Above Threshold Reprogrammings	-323			
d. Below Threshold Reprogrammings	1,887			
e. Rescissions	-39			
f. Line Item Veto		-1,500		
(U) g. Adjustments to Budget Years Since FY 1998 PB			-468	
(U) Current Budget Submit/FY 1999 PB	25,279	21,622	23,244	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603601F Conventional Weapons Technology								670A	
COST (\$ in Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
670A	Ordnance Technology	17,233	10,628	9,981	7,951	11,477	12,670	15,971	Continuing	Continuing	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> This project develops and demonstrates the effectiveness and operational utility of conventional (non-nuclear) ordnance technologies for current and future air-delivered weapons. The project develops the following technologies: fuzes; energetic, insensitive, and less sensitive explosives; hard target warheads; explosives, bombs, submunitions, and their dispensing mechanisms; weapon airframes and carriage; smart submunitions; and weapon ordnance subsystem integration.</p> <p>(U) <b>FY 1997 (\$ in Thousands):</b></p> <ul style="list-style-type: none"> <li>- (U) \$9,486 Develop advance air-delivered and submunition technologies for components and subsystems to increase performance, lethality, safety, affordability, and supportability.</li> <li>- (U) Completed flight test demonstration of a 250-pound class miniature munition.</li> <li>- (U) Completed delivery of antimateriel warheads for flight testing.</li> <li>- (U) Completed trade studies on dense metal case penetrating warhead.</li> <li>- (U) Completed in-house testing of an antimateriel submunition and fabrication of instrumented and live-fire units for flight testing to demonstrate advanced antimateriel submunition technology which is highly effective against all mobile ground targets.</li> <li>- (U) Completed testing of weapon concept for defeating biological weapons in storage facilities.</li> <li>- Demonstrate advanced weapon airframe and carriage technologies for munitions and submunitions to demonstrate operational effectiveness.</li> <li>- (U) Integrated and ground-tested a Global Positioning System/Inertial Navigation System (GPS/INS) jam resistant receiver demonstration unit in a weapon flight test vehicle.</li> <li>- (U) Developed overall air-to-air missile concept and conducted technology trade studies.</li> <li>- (U) \$17,233 Total</li> </ul>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603601F Conventional Weapons Technology	670A	
(U) FY 1998 (\$ in Thousands):			
- (U) \$3,444	Develop advanced air-delivered munition technologies for components and subsystems to increase performance, lethality, safety, affordability, and supportability.		
- (U) \$5,793	- (U) Complete preliminary design and subscale testing for dense metal case penetrating weapon for defeating very hard targets. - (U) Perform testing of warhead payloads for neutralizing chemical and biological weapons in production and storage facilities. Demonstrate advanced weapon airframe and carriage technologies for munitions and submunitions to demonstrate operational effectiveness. - (U) Complete ground testing of suspension and release equipment for future fighter aircraft which will reduce size, weight, and supportability issues associated with conventional pyrotechnic racks, maximize weapon loadout, and reduce drag and radar cross section. - (U) Conduct integrated submunition ground testing.		
- (U) \$1,391	- (U) Complete initial design of a tactical Ladar Seeker for the Low-Cost Autonomous Attack System munition; develop initial design of a three-dimensional model matching automatic target recognition (ATR) algorithms.		
- (U) \$10,628	- (U) Complete design specifications for an affordable dispensing system that will provide large aircraft loadouts of small smart submunitions. Develop advanced ordnance, fuze, and initiation subsystem technologies for improved effectiveness against hard targets. - (U) Complete requirements study and conceptual design of a multi-event fuze for initiating simultaneous or sequential warhead events. Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,783	Develop advanced air-delivered munition technologies for components and subsystems to increase performance, lethality, safety, affordability, and supportability.		
- (U) \$6,473	- (U) Complete detail design and conduct full-scale sled and flight testing for dense metal case penetrating weapon for defeating very hard targets. - (U) Perform detailed analysis and design of an integrated imaging infrared target detection device and directional warhead. Demonstrate advanced weapon airframe and carriage technologies for munitions and submunitions to demonstrate operational effectiveness - Complete design and fabrication of a tactical laser radar seeker for the Low-Cost Autonomous Attack System (LOCAAS) munition; complete design and laboratory testing of three-dimensional model matching automatic target recognition algorithms for the LOCAAS munition. - Complete design of a low-cost captive dispensing system that will permit large loadouts of small smart munitions on current and future aircraft.		
- (U) \$1,725	Develop advanced fuze and initiation subsystem technologies for improved effectiveness against hard targets.		
- (U) \$9,981	- (U) Complete design and component testing of a multi-event fuze for initiating simultaneous or sequential warhead events. Total		

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603601F Conventional Weapons Technology

670A

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	15,638	11,403	10,182	Cost
(U) Current Budget Submit/FY 1999 PB	17,233	10,628	9,981	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602602F, Conventional Munitions.
- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604407D, Joint Standoff Weapon.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603601F Conventional Weapons Technology

PROJECT

670B

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
670B Guidance Technology		8,046	10,994	13,263	16,032	12,371	11,519	8,636	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops and demonstrates affordable, autonomous, and adverse-weather advanced guidance technologies for conventional armament. Objectives include: increased accuracy, adverse-weather operation; real-time targeting and battle damage assessment enhanced target classification/identification; standoff delivery munitions; detection and "lock-on" of reduced signature targets; improved survivability; more reliable system operation; improved countermeasure performance; highly agile weapon control and enhanced affordability.

## (U) FY 1997 (\$ in Thousands):

- (U) \$7,091 Developed and demonstrated affordable, autonomous, and adverse-weather advanced air-to-surface guidance technologies.
- (U) Fabricated and ground-tested an optical correlator and laser radar for autonomous target identification in a cluttered environment.
- (U) Fabricated and bench-tested an affordable, autonomous, adverse-weather capable, precision synthetic aperture radar seeker; integrated with GBU-15 guidance and control subsystems.
- (U) Assessed degree of commonality of components across seekers designed for direct attack, submunition, and cruise missile operations; identified critical technical issues for each design; and focused development of critical component technologies for the direct attack munition seeker design to support testbed fabrication.
- (U) \$955 Developed and demonstrated guidance technologies and affordable, reliable components to counter the next generation air-to-air threats.
- (U) Conducted analyses on an advanced digital electronic processor for weapons seeker applications.
- (U) \$8,046 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$6,744 Develop and demonstrate affordable, autonomous, and adverse-weather capable seeker/processor technologies.
- (U) Complete ground-testing and captive flight test of an optical correlator and laser radar (LADAR) for autonomous target identification in a cluttered environment.
- (U) Complete integration of the Synthetic Aperture Radar-guided GBU-15 with F-16; conduct captive flight test of an affordable, autonomous, adverse-weather capable, precision, synthetic aperture radar seeker.
- (U) Complete development of required hardware and software for the technology brassboard seeker; produce detailed advanced solid state LADAR seeker design.
- (U) Develop overall program to demonstrate capabilities of conformal electronically scanned array seeker to be used in conjunction with advanced control technology.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
3 - Advanced Technology Development	0603601F Conventional Weapons Technology		670B	
- (U) \$2,046	- (U) Develop an advanced digital electronic processor for weapons seeker; develop parallel algebraic logic technology.			
- (U) \$2,204	- (U) Develop and demonstrate advanced flight control technologies capable of controlling and maneuvering highly agile flight vehicles.			
- (U) \$10,994	- (U) Conduct wind tunnel tests to characterize aerodynamic characteristics of the test vehicle; initiate tactical missile concept development, avionics hardware design, and reaction jet control system design.			
- (U) \$10,994	- (U) Develop and demonstrate highly accurate reliable and affordable advanced guidance technologies.			
- (U) \$10,994	- (U) Define system requirements definition for an extended range, precision guided 250-pound miniaturized munition that provides the target penetration performance and effectiveness of a 2000-pound munition			
- (U) \$10,994	- (U) Conduct free-flight tests of a high anti-jam global positioning system/inertial navigation system guided weapon to demonstrate performance in high jam environments.			
- (U) \$10,994	Total			
(U) FY 1999 (\$ in Thousands):				
- (U) \$7,615	Develop and demonstrate affordable, autonomous, and adverse-weather capable seeker/processor technologies.			
- (U) \$7,615	- (U) Conduct free-flight demonstrations of an affordable, autonomous, adverse-weather capable, precision synthetic aperture radar seeker.			
- (U) \$7,615	- (U) Fabricate an advanced solid state laser radar seeker; develop captive flight plan for FY 2000 tests.			
- (U) \$7,615	- (U) Begin development of a conformal electronically scanned array seeker design to provide instantaneously accessible large field-of-regard.			
- (U) \$2,648	Develop and demonstrate advanced flight control technologies capable of controlling and maneuvering highly agile flight vehicles.			
- (U) \$3,000	- (U) Conduct extensive developmental ground tests and analysis of solenoid actuated, reaction jet weapon controls.			
- (U) \$3,000	Develop and demonstrate highly accurate reliable and affordable advanced guidance technologies.			
- (U) \$13,263	- (U) Complete design and fabrication for an extended range, precision guided 250-pound miniaturized munition that provides the target penetration performance and lethality of a 2000-pound munition; initiate aircraft integration efforts to prepare for flight tests.			
- (U) \$13,263	Total			

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PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603601F Conventional Weapons Technology

670B

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	8,116	14,824	13,530	Cost
(U) Current Budget Submit/FY 1999 PB	8,046	10,994	13,263	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0602111N, Anti-Air/Anti-Surface Warfare Technology.
- (U) PE 0603792N, Advanced Technology Demonstrations.
- (U) PE 0604618F, Joint Direct Attack Munitions.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603605F

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PE TITLE: Advanced Weapons Technology

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BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603605F Advanced Weapons Technology									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		55,467	50,832	40,153	40,138	39,975	39,810	41,855	Continuing	Continuing	
3150 Advanced Optics Technology		11,423	16,506	1,362	1,674	2,549	2,625	2,712	Continuing	Continuing	
3151 High Power Semiconductor Laser Technology		4,336	5,850	9,845	11,175	9,508	9,793	10,118	Continuing	Continuing	
3152 High Power Microwave Technology		14,323	6,955	7,373	7,419	8,332	8,557	8,781	Continuing	Continuing	
3647 High Energy Laser Technology		25,385	21,521	21,573	19,870	19,586	18,835	20,244	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program demonstrates advanced directed energy and optical imaging concepts. Speed-of-light weapons and long-range, high resolution optical imaging through the turbulent atmosphere offer significant payoffs for many Air Force missions, such as theater missile defense, suppression of enemy air defenses, and control of space. This program has already demonstrated many major technological breakthroughs such as removing significant atmospheric distortions from optical transmissions (e.g., laser beams) and producing small, relatively high power laser diode phased arrays. Major emphasis areas include: high power microwave and high energy laser technologies; long-range optical imaging; and high power laser diodes and diode arrays. Because of the unique effects associated with high power microwaves there are many potential applications ranging from low power disruptions to high power destruction of electronic devices. Thus, a wide range of high power microwave technologies are being developed. Within high energy lasers the emphasis is on developing methods to increase the power on target. This is done by continuing to remove more of the atmospheric degradations and to develop more efficient laser devices. Long-range optical imaging offers high resolution images of space objects from the ground for applications such as satellite status assessments. High power diodes offer great potential for very small optical sources at many wavelengths for applications such as infrared illuminators and infrared countermeasure sources as well as high data rate secure communications. This PE will continue to develop a wide range of directed energy technologies for many DoD applications. Note: Congress added \$10 million for space laser imaging and \$6 million for Field Laser Demonstrator upgrades in FY 1998 which explains the perceived decrease in FYs 1999 and out.

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## 3 - Advanced Technology Development

0603605F Advanced Weapons Technology

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	54,027	41,238	41,660	
(U) Appropriated Value	56,895	55,238		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,723	-3,629		
b. SBIR	-1,145	-777		
c. Omnibus/Other Above Threshold Reprogrammings	-97			
d. Below Threshold Reprogrammings	1,627			
e. Rescissions	-90			
(U) Adjustments to Budget Year Since FY 1998 PB			-1,507	
(U) Current Budget Submit/FY 1999 PB	55,467	50,832	40,153	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603605F Advanced Weapons Technology

3150

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3150 Advanced Optics Technology	11,423	16,506	1,362	1,674	2,549	2,625	2,712	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project develops advanced optical technologies for locating, identifying, and analyzing distant and/or dim objects. This work supports high energy laser technologies because an imaging subsystem is required for target verification, accurate and sustainable laser beam placement on target, and near-real-time damage assessment. Several advanced technologies including nonlinear optics, adaptive optics, and specialized signal processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of the technologies developed/being developed have significant application to astronomy research.

## (U) FY 1997 (\$ in Thousands):

- (U) \$680 Develop and demonstrate advanced optical imaging technologies that support applications such as space object imaging.
- (U) \$309 Transitioned technology for daytime imaging of low-earth orbit satellites to the Maui Space Surveillance System 3.67 meter telescope. This capability dramatically increases the number of satellites imaged each day.
- (U) \$844 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
- (U) \$9,590 Constructed, characterized, and demonstrated a laboratory breadboard of the telescope subsystem for an ultra-high resolution, lightweight imaging satellite telescope concept which uses nonlinear optics to compensate for deformations in a large diameter deployable primary mirror.
- (U) \$11,423 Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
- (U) \$9,590 Began development of field hardware to demonstrate feasibility of long-range optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
- (U) \$11,423 Develop technologies for active imaging of geosynchronous space objects.
- (U) \$11,423 Conducted active imaging field tests and demonstrations.
- (U) \$11,423 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603605F Advanced Weapons Technology	3150	
(U) FY 1998 (\$ in Thousands):			
- (U) \$845	Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.		
	- (U) Continue development of field hardware to demonstrate feasibility of long-range passive optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.		
	- (U) Demonstrate target identification using multispectral images from space to improve battle damage assessment and allow imagery of targets under all types of camouflage while reducing satellite size, weight, and cost.		
- (U) \$514	Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.		
	- (U) Design and model a brassboard based on the FY 1997 telescope subsystem breadboard for characterization in a space environmental chamber to evaluate operational properties.		
- (U) \$233	Develop and demonstrate signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.		
	- (U) Complete analysis and initiate field experiments to demonstrate spectral classification and status of satellites.		
- (U) \$9,321	Develop technologies for active imaging of geosynchronous space objects.		
	- (U) Conduct active imaging field tests and demonstrations.		
- (U) \$5,593	Upgrade the Field Laser Demonstrator for increased resolution.		
	- (U) Develop hardware and techniques to obtain very accurate data on space objects (position, velocity, etc) and techniques for remote sensing of the atmosphere (detect hazardous agents, etc).		
- (U) \$16,506	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$618	Develop and demonstrate advanced technologies which increase resolution and data fusion for very long-range optical imaging to support missions such as space object identification and ground target identification from space.		
	- (U) Continue development of field hardware to demonstrate feasibility of long-range passive optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.		
- (U) \$548	Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.		
	- (U) Construct the ultra-high resolution, lightweight imaging satellite telescope brassboard designed in FY 1998 and evaluate in a space environmental chamber to determine actual capabilities.		
- (U) \$196	Develop and demonstrate signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.		
	- Demonstrate utility of spectral classification and operational status analysis of satellites from data collected with the Ground-Based Electro-Optical Deep Space Surveillance test site.		
- (U) \$1,362	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
3 - Advanced Technology Development		0603605F Advanced Weapons Technology	3150
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 1998 PB)	11,442	1,707	1,589
(U) Current Budget Submit/FY 1999 PB	11,423	16,506	1,362
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0305910F Spacetrack			
- (U) PE 0305160F, Defense Meteorological Satellite Program.			
- (U) PE 0602102F, Materials.			
- (U) PE 0602601F, Phillips Laboratory.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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BUDGET ACTIVITY		RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998				
3 - Advanced Technology Development		PE NUMBER AND TITLE		0603605F Advanced Weapons Technology		PROJECT 3151				
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3151	High Power Semiconductor Laser Technology	4,336	5,850	9,845	11,175	9,508	9,793	10,118	Continuing	Continuing

**(U) A. Mission Description and Budget Item Justification:** This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources with low to moderate optical power. This is a long-term technology development project with both near-term and long-term goals. Near-term goals include developing compact, reliable infrared sources for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources for military applications including aircraft protection. This project leads the development of and builds upon a wide range of commercial advancements. Commercially available semiconductor lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers/efficiencies and/or to military application-specific wavelengths. The project is divided into three technology areas. The first area investigates methods to increase output power from individual laser diodes while increasing power density onto a small spot. Secondly, semiconductor laser array integration methods, which produce a single, high quality laser beam at significantly higher power levels are developed. Thirdly, wavelength-specific laser diodes for military applications are developed. Project scientists/managers also work directly with field users to develop proof-of-capability demonstrations and field tests for these revolutionary laser sources. This technology has many commercial applications, especially for eye-safe lasers.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$2,360 Develop laser diodes for improved performance/higher power in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
- (U) Demonstrated four watts of continuous wave output power from a single-mode fiber, improving current semiconductor laser state-of-the-art by a factor of 1.5. This demonstration identified technical issues which must be solved to reach higher power levels for increased space laser communication data rates and increased system security.
- (U) Demonstrated devices that have the potential to be modulated and scaled to high powers.
- (U) \$1,071 Develop laser diode arrays for improved performance/higher power in applications requiring high power levels and beam quality such as designating and tracking for Airborne Laser (ABL) and Ground-Based Laser (GBL).
- (U) \$905 Developed phasing methods for the 200 watt continuous output power diode laser array developed in FY 1996.
- (U) Demonstrate high power laser diode array technology that incorporates size limitations necessary for integration into system application designs.
- (U) Demonstrated 200 watts continuous wave output power from a one cubic foot laser head. This laser design demonstrated the feasibility of a compact, high-power laser system.
- (U) \$4,336 Total

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603605F Advanced Weapons Technology

3151

(U) FY 1998 (\$ in Thousands):

- (U) \$1,386 Develop laser diodes for improved performance/higher power as sources in near-term applications such as infrared countermeasures, illumination, designation, and communication and for incorporation into laser diode array architectures.
- (U) Identify and resolve reliability and failure mode issues to validate advanced high power, reliable, long-life diode lasers operating at 980 nanometers wavelength.
- (U) Demonstrate one watt, continuous wave, diffraction-limited output power at 1.55 micrometers wavelength to extend the capabilities of current and future communication systems and enhance eye-safe sources.
- (U) \$979 Develop coherent laser diode arrays for improved performance/higher power as sources in applications requiring high power levels.
- (U) Evaluate design and trade off decisions related to high power semiconductor diode array ruggedness, compactness, and portability for integration into system application designs.
- (U) \$1,660 Develop semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-wing aircraft. Development will focus on concepts with the potential for high efficient, compact infrared laser sources covering Bands 2 and 4.
- (U) Demonstrate one watt coherent peak output power at quasi-continuous wave operation from a single, Band 2 semiconductor diode at an operating temperature of 200 degrees Kelvin. This device will demonstrate the necessary powers needed to jam Band 2 infrared surface-to-air missiles.
- (U) Demonstrate two watts coherent peak output power at quasi-continuous wave operation from a single, Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin. The collected data will demonstrate the necessary powers needed to jam Band 4 infrared surface-to-air missiles.
- (U) \$1,825 Develop the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation imaging advanced infrared guided air-to-air and surface-to-air missiles.
- (U) Construct a first generation surrogate imaging threat to be used in laboratory testing. This surrogate is necessary as the availability of real world missile seeker assets to be used in destructive testing is severely limited and cost prohibitive.
- (U) Demonstrate damage to representative focal plane array, the detector used in an imaging missile, from illumination with moderate power pulsed laser device.
- (U) \$5,850 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	3151
3 - Advanced Technology Development	0603605F Advanced Weapons Technology		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,869	Develop laser diodes for improved performance/higher power as sources in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.		
	- (U) Demonstrate a factor of three increase (three watts) in continuous wave, diffraction limited output power at 1.55 micrometers wavelength to enable new system concepts for communications.		
	- (U) Identify and resolve reliability and failure mode issues to validate advanced high-power, reliable long-life diode laser systems operating at 1.55 micrometers wavelength.		
- (U) \$1,127	Develop scalable laser arrays (fiber/diode) for improved performance in applications requiring high power levels and beam quality such as designating/tracking sources for the airborne laser and ground based laser applications and as weapon sources for degrade and damage in aircraft self-protection applications.		
	- (U) Demonstrate a fieldable 0.1 cubic foot, 100 watt, steerable near-infrared building block laser array head. This array will demonstrate the practicality for scaling to the multi-kilowatt power levels required for next generation weapons systems.		
- (U) \$3,908	Develop semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-winged aircraft. Development will focus on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.		
	- (U) Demonstrate one watt peak output power from a Band 2 semiconductor laser at an operating temperature of 200 degrees Kelvin with a beam quality compatible with the DoD tri-Service Advanced Threat IRCM (ATIRCM) system. This demonstration will provide the necessary beam quality needed to directionally focus power downrange and jam Band 2 infrared surface-to-air missiles.		
	- (U) Demonstrate two watts peak output from a Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin with a beam quality compatible with the DoD tri-Service ATIRCM system. This device will demonstrate the necessary beam quality needed to directionally focus the power downrange and jam Band 4 surface-to-air missiles.		
- (U) \$2,941	Develop the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation imaging advanced infrared guided air-to-air and surface-to-air missiles.		
	- (U) In a static field test, demonstrate damage to seeker of the first generation surrogate imaging threat sufficient to cause the missile to miss the target aircraft.		
	- (U) Perform hardware-in-the-loop testing of damage mechanisms within the surrogate imaging threat. This testing will verify that damage caused in the static field test is sufficient to cause surrogate system malfunction, and that a missile guidance system would be sufficiently degraded to cause a low probability of missile impact with the target aircraft.		
	- (U) Construct an improved surrogate threat to be used in laboratory testing. This surrogate, to be ready for testing in FY 2000, will be of higher fidelity than the first generation surrogate developed in FY 1998.		
- (U) \$9,845	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603605F Advanced Weapons Technology</b>	<b>3151</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="0"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>4,440</td> <td>6,410</td> <td>10,043</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>4,336</td> <td>5,850</td> <td>9,845</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:  Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602102F, Materials.</li> <li>- (U) PE 0602204F, Aerospace Avionics.</li> <li>- (U) PE 0603270F, Electronic Combat Technology</li> <li>- (U) PE 0602601F, Phillips Laboratory.</li> <li>- (U) PE 0602234N, Systems Support Technology.</li> <li>- (U) Representatives from Army, Navy, Ballistic Missile Defense Organization, National Laboratories, and Air Force using commands are members of the government review team for this technology.</li> <li>- (U) Joint field demonstrations of this technology are ongoing with: the Air Force Pararescue School; the Air Force Special Operations Command; the U.S. Coast Guard; and the U.S. Customs Service.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	4,440	6,410	10,043	Cost	(U) Current Budget Submit/FY 1999 PB	4,336	5,850	9,845	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	4,440	6,410	10,043	Cost														
(U) Current Budget Submit/FY 1999 PB	4,336	5,850	9,845	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

PROJECT

0603605F Advanced Weapons Technology

3152

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3152 High Power Microwave Technology	14,323	6,955	7,373	7,419	8,332	8,557	8,781	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project develops high power microwave generation technologies. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to high power microwave threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets will be tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. The technologies developed in this project will demonstrate the applicability of high power microwaves that can damage/degrade/deny/destroy electronic systems and subsystems for missions such as suppression of enemy air defense, command and control warfare, and aircraft self-protection.

## (U) FY 1997 (\$ in Thousands):

- (U) \$3,125 Develop suppression of enemy air defense technologies.
  - (U) Conducted experiments on selected integrated air defense assets.
  - (U) Completed detailed systems engineering specifications for high power microwave suppression of enemy air defenses weapon concept.
- (U) \$3,004
  - (U) Completed explosive pulse power development for suppression of enemy air defenses weapon concept.
  - (U) Completed source development for suppression of enemy air defenses weapon concept.
  - (U) Develop aircraft self-protection technologies.
  - (U) Completed high power microwave hardening criteria evaluation for large U.S. aircraft.
  - (U) Completed required electromagnetic hardening on range assets used for technology demonstration field test.
  - (U) Continued development of wideband high power microwave brassboard for field demonstrations.
  - (U) Conducted laboratory experiments on missiles to identify alternative/enhanced kill mechanisms.
  - (U) Completed technology demonstration field test planning.
  - (U) Initiated plan to transition technology to large aircraft system program offices.
- (U) \$1,168 Develop command and control warfare technologies.
  - (U) Continued equipment characterization of command and control assets.
  - (U) Expanded propagation studies and models for various construction materials/techniques.
  - (U) Continued development of wideband sources and antennas for command and control warfare applications.
  - (U) Initiated studies of potential delivery and implementation techniques.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603605F Advanced Weapons Technology	3152	
- (U) \$4,795	Develop laser-induced microwave emissions technology.		
- (U)	Validated the integrated response model of the laser-induced microwave emission phenomenon.		
- (U)	Completed experiments, begun in FY 1996, on operational systems and developed draft hardening specifications.		
- (U)	Completed feasibility experiments and analyzed results for various applications.		
- (U) \$500	Develop active denial technology.		
- (U)	Began application concept studies for next-generation technology.		
- (U) \$ 1,731	Develop high power microwave space control technologies.		
- (U)	Completed concept study threat basing mode analysis.		
- (U)	Performed subsystem and component level susceptibility experiments on satellite communication, imaging, and control technologies.		
- (U)	Evaluated source technologies for threat demonstration.		
- (U) \$14,323	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$3,014	Develop suppression of enemy air defense technologies.		
- (U)	Conduct critical experiments of integrated pulsed power generator and high power microwave source.		
- (U)	Conduct subsystem level effects test of an integrated air defense asset.		
- (U)	Start engineering design of high power microwave suppression of enemy air defenses weapon brassboard.		
- (U) \$2,271	Develop technologies to support advanced tactical applications.		
- (U)	Complete wideband high power microwave brassboard for technology demonstration field test.		
- (U)	Conduct field experiments for demonstrate self-protect technology.		
- (U)	Complete plan to transition technology to large aircraft systems program office.		
- (U)	Final assessment of wideband high power microwave technology's ability to effectively counter missile threats prior to transition to large aircraft system program offices.		
- (U) \$1,198	Develop command and control warfare technologies.		
- (U)	Expand equipment characterization experiments and effects database.		
- (U)	Begin selection of wideband source and pulse power designs.		
- (U)	Develop delivery and implementation options.		
- (U) \$472	Develop active denial technology.		
- (U)	Continue application concept studies for next-generation technology.		
- (U) \$6,955	Total		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>		<b>0603605F Advanced Weapons Technology</b>	<b>3152</b>

  

(U) FY 1999 (\$ in Thousands):	
- (U) \$3,354	Develop suppression of enemy air defense technologies.
	- (U) Complete critical experiment of high power microwave suppression of enemy air defenses technologies.
	- (U) Continue to conduct experiments on selected integrated air defense assets.
	- (U) Initiate advanced repetitive source development for suppression of enemy air defenses.
- (U) \$2,357	Develop technologies to support advanced tactical applications.
	- (U) Continue development of high power microwave sources and antennas for aircraft self-protect and other advanced tactical applications.
	- (U) Continue to assess candidate high power microwave weapon effects on U.S. and foreign systems and identify mitigation technologies.
	- (U) Begin to develop or adapt engagement models for candidate weapon systems.
- (U) \$1,172	Develop command and control warfare technologies.
	- (U) Finalize first wideband source and pulse power design for ground control network application.
	- (U) Complete initial equipment characterization of command and control assets.
	- (U) Continue effects experiments on electromagnetic propagation into command and control facilities.
- (U) \$490	Develop active denial technology.
	- (U) Continue application concept studies for next-generation technology.
- (U) \$7,373	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT															
3 - Advanced Technology Development		0603605F Advanced Weapons Technology	3152															
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>14,347</td> <td>7,363</td> <td>7,521</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>14,323</td> <td>6,955</td> <td>7,373</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:            Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602202F, Human Systems Technology.</li> <li>- (U) PE 0602601F, Phillips Laboratory.</li> <li>- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.</li> <li>- (U) PE 0602111N, Anti-Air Warfare, Anti-Surface Warfare Technology.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	14,347	7,363	7,521	Cost	(U) Current Budget Submit/FY 1999 PB	14,323	6,955	7,373	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	14,347	7,363	7,521	Cost														
(U) Current Budget Submit/FY 1999 PB	14,323	6,955	7,373	Cont														

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603605F Advanced Weapons Technology

PROJECT

3647

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3647 High Energy Laser Technology	25,385	21,521	21,573	19,870	19,586	18,835	20,244	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification:** This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons. Near-term focus is on ground-based and airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies demonstrated include: scalable laser devices, with near-term emphasis on the Chemical Oxygen-Iodine Laser (COIL); optical components; and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability will be developed. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. The beam control technology developed in this project has a significant benefit to the astronomy community.

(U) FY 1997 (\$ in Thousands):

- (U) \$2,970 Develop and demonstrate high energy laser components for potential weapon applications.
- (U) Identified specific energy loss mechanisms in chemical oxygen-iodine laser (COIL) devices, based on results of COIL diagnostic testing and modeling, and began development of advanced concepts to reduce losses and improve COIL device performance.
- (U) Developed the magnetic gain switch hardware necessary to efficiently operate a COIL device as a repetitively-pulsed laser, a necessary step in using a wavelength-shifted COIL device in illuminator applications.
- (U) \$1,468 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
- (U) Continued to conduct laser vulnerability experiments on satellite subsystems.
- (U) Continued to perform detailed vulnerability analysis on satellite optical payload systems.
- (U) Continued detailed satellite vulnerability assessments on satellites using newly incorporated uncertainty methodology.
- (U) Continued assessing the potential of near-term laser countermeasures on satellites.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603605F Advanced Weapons Technology	3647	
- (U) \$10,120	Perform atmospheric compensation/beam control experiments from ground-based and airborne platforms to support applications ranging from weaponization to space object identification.		
	- (U) Began design of a two laser beacon system for full-scale atmospheric compensation on the 3.5 meter telescope.		
	- (U) Demonstrated real-time compensation of atmospheric turbulence-induced distortions on satellite images.		
	- (U) Installed 500 watt laser tracking illuminator system and began satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite tracking.		
	- (U) Completed integration of first-generation adaptive optics on Starfire Optical Range (SOR) 3.5 meter telescope and began imaging tests using stars. Testing results will identify hardware and software issues which need to be addressed to improve atmospheric compensation performance.		
	- (U) Continued development of second-generation adaptive optics system to maximize resolution and compensation of the SOR 3.5 meter telescope.		
- (U) \$10,827	Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing system to enhance boost phase theater ballistic missile tracking.		
	- (U) Completed analysis and evaluation of global atmospheric optical data taken in FY 1995 airborne experiments.		
	- (U) Collected atmospheric athermal data for strategic locations worldwide to develop parametric database for high energy laser operational assessments analysis.		
	- (U) Correlated atmospheric athermal and optical parameters in an analytical model to provide a cost-effective method of determining laser weapon effectiveness against specific threats.		
	- (U) Designed near full-scale acquisition, tracking, and pointing experiments to demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments were conducted at White Sands Missile Range, NM.		
	- (U) Designed small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.		
- (U) \$25,385	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603605F Advanced Weapons Technology	3647	
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,550	Develop and demonstrate high energy laser components for potential weapon applications.		
	- (U) Increase fieldability of the Chemical Oxygen Iodine Laser (COIL) for airborne and ground-based weapon systems by examining new nozzle designs, transport gases, and cavity design to increase efficiency, and reduce size and weight.		
	- (U) Demonstrate repetitively-pulsed COIL device suitable for use in wavelength-shifted COIL illuminator laser applications.		
	- (U) Select Raman wavelength-shifting concept and begin design of laboratory hardware to demonstrate high average power when coupled with a repetitively-pulsed COIL device.		
- (U) \$1,822	Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.		
	- (U) Continue to conduct laser vulnerability experiments on satellite subsystems.		
	- (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.		
	- (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.		
	- (U) Continue assessing the potential of near-term laser countermeasures on satellites.		
- (U) \$914	Investigate and develop advanced, high energy laser optical components.		
	- (U) Continue to develop and evaluate techniques to monitor optical components installed in future operational high-energy laser systems.		
	- (U) Continue to optimize deposition techniques and characterization of low absorption, low-scatter optical thin film coatings for uncooled optics and other specialized applications. Transfer technology to industry for scaling.		
	- (U) Build and evaluate the performance of a cooled, transmissive optical element in the Thermal Distortion Test Facility. Determine the distortion due to simulated high-energy laser heating.		
- (U) \$9,668	Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.		
	- (U) Complete design and begin development of two-laser beacon system for atmospheric compensation on the 3.5 meter telescope.		
	- (U) Integrate second-generation adaptive optics system on 3.5 meter telescope to improve image quality of observed space objects.		
	- (U) Continue satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite acquisition and tracking capability.		
- (U) \$6,567	Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boost phase theater ballistic missile tracking.		
	- (U) Conduct near full-scale tracking and pointing experiments that demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets. The experiments will be conducted at White Sands Missile Range, NM.		
	- (U) Conduct small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.		
- (U) \$21,521	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603605F Advanced Weapons Technology	3647	
(U) FY 1999 (\$ in Thousands):			
- (U) \$2,185	Develop and demonstrate high energy laser components for potential weapon applications.		
	- (U) Demonstrate improved performance and fieldability with the Chemical Oxygen Iodine Laser (COIL) and support enhanced transition to the Airborne Laser system acquisition program.		
	- (U) Demonstrate a repetitively pulsed, high average power, frequency-shifted COIL device for use as a target illuminator.		
- (U) \$1,693	- (U) Conduct high power laser technology development to ensure operation control of space and the tactical and strategic theaters.		
	Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.		
	- (U) Continue to conduct laser vulnerability experiments on satellite subsystems.		
	- (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.		
	- (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.		
- (U) \$746	- (U) Continue assessing the potential of near-term laser countermeasures on satellites.		
	Investigate and develop advanced, high energy laser optical components.		
	- (U) Continue to evaluate techniques to monitor optical components installed in an future operational high-energy laser systems. Transfer monitoring equipment to users. Such techniques are useful for predicting performance degradation and/or catastrophic failure of an optical component in an operational high energy laser system.		
	- (U) Continue to optimize very low absorption, low-scatter optical thin film coatings. Transfer technology to industry for scaling. Low absorption, low scatter, durable coatings are critical to the performance of uncooled optics planned for future high-energy laser systems.		
- (U) \$11,200	Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.		
	- (U) Demonstrate atmospheric compensation of images using dual laser beacon system on 3.5 meter telescope.		
	- (U) Continue active satellite tracking to investigate phenomena resulting from satellite illumination at various engagement geometries.		
	- (U) Demonstrate compensated laser propagation to satellites on 3.5 meter telescope.		
	- (U) Use track jitter compensation with atmospheric compensation and active tracking to point a laser with sufficient accuracy to maintain a selected aimpoint on a satellite target.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603605F Advanced Weapons Technology		3647
- (U) \$5,749	Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boot phase theater ballistic missile tracking.		
-	(U) Collect atmospheric aerothermal data for strategic locations worldwide to develop parametric database for high energy laser operational assessments analysis.		
-	(U) Continue near full-scale acquisition, tracking, and pointing experiments that demonstrate and validate atmospheric compensation, target tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments will be conducted at White Sands Missile Range, NM.		
-	(U) Instrument an aircraft for use as a dynamic target in White Sands Missile Range, NM, atmospheric propagation experiments. The aircraft will gather data to support future Airborne Laser technology development/risk reduction experiments.		
-	(U) Continue small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.		
- (U) \$21,573	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT															
BUDGET ACTIVITY	PE NUMBER AND TITLE																	
<b>3 - Advanced Technology Development</b>	<b>0603605F Advanced Weapons Technology</b>		<b>3647</b>															
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total Cost</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>23,798</td> <td>25,758</td> <td>22,507</td> <td>Cont</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>25,385</td> <td>21,521</td> <td>21,573</td> <td>Cont</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:  Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602601F, Phillips Laboratory.</li> <li>- (U) PE 0603319F, Airborne Laser Demonstration.</li> <li>- (U) PE 0305910F, Spacetrack.</li> <li>- (U) PE 0603217C, Ballistic Missile Defense, Advanced Development (High Altitude Balloon Experiment).</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total Cost	(U) Previous President's Budget (FY 1998 PB)	23,798	25,758	22,507	Cont	(U) Current Budget Submit/FY 1999 PB	25,385	21,521	21,573	Cont
	FY 1997	FY 1998	FY 1999	Total Cost														
(U) Previous President's Budget (FY 1998 PB)	23,798	25,758	22,507	Cont														
(U) Current Budget Submit/FY 1999 PB	25,385	21,521	21,573	Cont														

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603707F Weather Systems Technology								2688	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2688	Weather Support Technology	3,175	1,943	1,568	1,562	1,361	1,141	0	Continuing	Continuing	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

Note: Beginning in FY 1998, Projects 2688, Weather Support Technology, 2781, Weather Radar Technology, and 4026, Centralized Support Technology, were combined within Project 2688. For clarity, FY 1997 funding reflects this consolidation.

(U) **A. Mission Description and Budget Item Justification:** New technologies for weather support forces and their operational customers are demonstrated and transitioned to the user in this Advanced Technology Development program. Technologies developed include new weather impact decision aids that will be incorporated into mission planning systems and used by battlefield commanders for optimum selection of electro-optical systems and tactics to accomplish mission objectives. The program also provides new technologies to improve global/theater support capabilities at the Air Force's Global Weather Center and Space Forecast Center. Improves the Air Force's ability to integrate information for weather forecasts in battle areas where data is denied. Develops models for forecasting conditions in the earth's neutral atmosphere, ionosphere, and magnetosphere which are needed to provide critical support to Air Force surveillance, communications, and other satellite assets. New global and theater weather forecast techniques that improve the Air Force's capability to provide centralized weather data are also developed.

(U) FY 1997 (\$ in Thousands):

- (U) \$300 Developed Tactical Forecast System analysis and forecast technology.
- (U) \$1,554 Completed development of artificial intelligence battlespace environment forecast model for in-theater operations.
- (U) \$735 Developed Battlespace Environment Impact Decision Aids.
- (U) \$202 Delivered advanced physics Night Vision Goggle Operations Weather Software to Air Force Special Operations Command/Air Combat Command that permits aircrews to avoid terrain hazards.
- (U) \$384 Evaluated infrared scene visualization system.
- (U) \$3,175 Completed and developed centralized battlespace environment support technology.
- (U) \$300 Delivered cloud layer, aircraft icing, and turbulence diagnostic algorithms to Air Force Global Weather Center.
- (U) \$202 Continued development of thunderstorm, aircraft icing, and turbulence diagnostic algorithms.
- (U) \$384 Developed space environmental algorithms.
- (U) \$3,175 Developed integrated space environmental model for 55<sup>th</sup> Space Weather Squadron (Air Force Space Command).
- (U) \$384 Developed severe battlespace environment prediction software.
- (U) \$3,175 Completed development of lightning algorithm for WSR-88D weather surveillance radar system.
- (U) \$3,175 Total

## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603707F Weather Systems Technology</b>		<b>2688</b>
(U) FY 1998 (\$ in Thousands):			
- (U)	\$1,339	Develop Battlespace Environment Impact Decision Aids.	
- (U)		- (U) Develop and deliver Night Vision Goggle Operations Weather Software Version 4.0 which predicts impact of city lighting on detection ranges, to Air Force Special Operations Command (AFSOC)/Air Combat Command (ACC).	
- (U)		- (U) Transition infrared scene visualization system to Air Force Mission Support System Program Office at Electronic Systems Center.	
- (U)	\$498	- (U) Initiate development of new target acquisition software and mission impact modules for weather decision aids.	
- (U)		Develop centralized weather support technology.	
- (U)	\$106	- (U) Deliver validated thunderstorm, aircraft icing, and turbulence diagnostic algorithms to Air Force Weather Agency (AFWA).	
- (U)		Develop space environmental algorithms.	
- (U)	\$1,943	- (U) Develop additional components for the integrated environmental model for Air Force Space Command.	
- (U)		Total	
(U) FY 1999 (\$ in Thousands):			
- (U)	\$834	Develop software that predicts the impact of weather on precision guided munitions during mission execution for Air Combat Command.	
- (U)		- (U) Transition Target Acquisition Weather Software V1.0 to ACC for evaluation.	
- (U)	\$628	Develop software to incorporate the impact of weather on precision guided munitions during preparation of the Air Tasking Order.	
- (U)		- (U) Demonstrate the value of Weather Automated Mission Planning Software to ACC.	
- (U)	\$106	Develop software that predicts the impact of weather on night vision goggle detection ranges.	
- (U)		- (U) Transition Night Vision Goggle Operations Weather software V5.0 to ACC and AFSOC.	
- (U)	\$1,568	Total	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603707F Weather Systems Technology

2688

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	3,273	2,036	2,056	
(U) Appropriated Value	3,406	2,036		
(U) Adjustments to Appropriated Value				
a. Congressional General Reductions	-71	-66		
b. SBIR	-62	-27		
c. Omnibus/Other Above Threshold Reprogrammings	-93			
d. Below Threshold Reprogrammings				
e. Rescissions	-5			
(U) Adjustments to Budget Year Since FY 1998 PB			-488	
(U) Current Budget Submit/FY 1999 PB	3,175	1,943	1,568	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) Related Activities:

- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0305111F, Weather Service.
- (U) PE 0602601F, Phillips Laboratory Exploratory Development.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 2688

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Exhibit R-2 (PE 0603707F)

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PE NUMBER: 0603723F

UNCLASSIFIED

PE TITLE: Environmental Engineering Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603723F Environmental Engineering Technology	2103	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate
2103 Environmental Quality Technology		7,412	3,786
Quantity of RDT&E Articles		0	0
		FY 1999 Estimate	FY 2000 Estimate
		2,663	3,202
		FY 2001 Estimate	FY 2002 Estimate
		1,431	2,458
		FY 2003 Estimate	Cost to Complete
		0	Continuing
		0	0
		0	0
		Continuing	Total Cost
		Continuing	0

Note: Beginning in FY 1998, Project 2103, Environmental Quality Technology, and Project 3037, Noise and Sonic Boom Impact Technology, are combined within Project 2103, Environmental Quality Technology. The total PE costs shown for FY 1997 reflect this consolidation.

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops and demonstrates advanced technologies to address Air Force-unique environmental problems and determines the effect of aircraft noise and sonic boom stimuli on humans, animals, and structures. Specific projects advance and integrate environmental issues and operating concerns into air base design, support, and maintenance. Develops and demonstrates advanced technologies to solve environmental restoration problems, reduce hazardous emissions from weapon systems, minimize Air Force industrial waste, and eliminate toxic pollutant releases from Air Force operations. Develops and demonstrates technologies to predict and evaluate the environmental impacts of noise from aircraft operations, as directed by the National Environmental Policy Act. Improving this capability aids in the timely response to public concerns, preparation of accurate environmental impact statements, and minimizing unfavorable legal challenges to Air Force operations.

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603723F Environmental Engineering Technology</b>	<b>2103</b>	

  

(U) FY 1997 (\$ in Thousands):	
- (U) \$2,133	Demonstrated technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
-	(U) Completed development of advanced air monitoring technology and characterization of atmospheric diffusion following catastrophic space launch aborts to validate space launch toxic risk assessment models for Vandenberg AFB, CA.
-	(U) Demonstrated additional in-place sensors and monitoring technologies to locate, identify, and monitor solvent contaminant sources and plumes; demonstrated direct push data point mapping and monitoring assessment using Global Positioning System (GPS) technology.
-	(U) Provided full-scale field evaluation of techniques to determine remediation rates of fuel/solvent contaminants (including natural or enhanced biodegradation).
- (U) \$4,219	Demonstrated technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
-	(U) Completed design and began construction of an air recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology; continued to develop and demonstrate affordable technologies to control air polluting emissions from Air Force industrial processes (to comply with Clean Air Act amendments).
-	(U) Developed cost-effective alternate processes and materials that reduce or eliminate the production of hazardous wastes and the use of hazardous materials; demonstrated non-chromate conversion coating on ion vapor deposition of aluminum; demonstrated spray casting as a replacement for cadmium/nickel plating.
-	(U) Developed chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) in waste water (including membrane separation, hydrogen peroxide treatment, direct nucleate flotation, and hydrothermal oxidation).
- (U) \$1,060	Developed and demonstrated noise effects assessment technology.
-	(U) Initiated study on the extent of military overflight noise impacts on national parks.
-	(U) Demonstrated the use of the animal noise monitor with GPS technology for assessment of the effects of military aircraft noise on free-ranging herd animals in military operating areas and on Air Force ranges.
-	(U) Developed model to determine the penetration of sonic booms into water for assessment of impacts on marine mammals.
- (U) \$7,412	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603723F Environmental Engineering Technology	2103	
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,026	Demonstrate technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.		
-	(U) Evaluate chemical fate and environmental transport of compounds of potential use to the Air Force or new to the Air Force inventory.		
-	(U) Begin development of immunochemical detection systems to provide inexpensive, accurate, and robust measurements of Air Force toxic wastes.		
-	(U) Begin adaptation of environmental sensor networks to air toxic monitoring.		
- (U) \$1,620	Demonstrate technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.		
-	(U) Continue development of a recirculating paint booth with biofilter and Volatile Organic Compounds (VOCs) emissions control technology; continue to develop and demonstrate affordable technologies to control air pollutant emissions from Air Force industrial processes (to comply with Clean Air Act amendments).		
-	(U) Continue to develop chemical/physical processes to treat oil/water wastes, emulsions, and aqueous film forming foam (AFFF) in waste water (including membrane separation, hydrogen peroxide treatment, direct nucleate flotation, and hydrothermal oxidation).		
-	(U) Continue to develop cost-effective alternate processes and materials that reduce or eliminate the production of hazardous wastes and the use of hazardous materials.		
- (U) \$1,140	Develop and demonstrate noise effects assessment technology.		
-	(U) Upgrade the Assessment System for Aircraft Noise (ASAN) with the ability to predict noise from military aircraft operating in subsonic military operating areas.		
-	(U) Conduct study to determine the effect of sleep disturbance habituation from aircraft noise.		
-	(U) Characterize the habitat of marine mammals exposed to military aircraft noise and develop baseline noise levels for Air Force use.		
- (U) \$3,786	Total		

Project 2103

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Exhibit R-2 (PE 0603723F)

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		<b>DATE</b> February 1998
<b>BUDGET ACTIVITY</b>	<b>PE NUMBER AND TITLE</b>	<b>PROJECT</b>
<b>3 - Advanced Technology Development</b>	<b>0603723F Environmental Engineering Technology</b>	<b>2103</b>

  

(U) FY 1999 (\$ in Thousands):	
- (U) \$1,100	Develop and demonstrate technologies and design criteria for improved monitoring, disposal, characterization, and assessment of risks to the environment posed by Air Force activities.
	- (U) Continue to evaluate chemical fate and environmental transport of compounds of potential use to the Air Force or new to the Air Force inventory.
	- (U) Develop monitoring capabilities for integration with horizontal boring technology to characterize and monitor Dense Non-Aqueous Phase Liquid (DNAPL).
- (U) \$1,263	Demonstrate technologies to reduce/destroy wastes and contamination of the environment by Air Force materials and operations.
	- (U) Demonstrate a full-scale emission control system based on recirculation and steady state biofiltration for use on paint booth exhausts.
	- (U) Demonstrate the application of hydrothermal oxidation reactor technology, coupled with chemical/physical separation technologies, for the destruction of paint stripping wastes.
- (U) \$ 300	Complete development and demonstration of technologies to clean up a variety of chemically contaminated DoD sites.
- (U) \$2,663	- (U) Complete protocol for intrinsic remediation of chlorobenzenes and nitrobenzenes at chlorinated solvents contaminated sites.
	Total

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603723F Environmental Engineering Technology

2103

## U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	7,520	4,084	4,857	
(U) Appropriated Value	7,885	4,084		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-181	-217		
b. SBIR	-184	-81		
c. Omnibus/Other Above Threshold Reprogrammings	-96			
d. Below Threshold Reprogrammings				
e. Rescissions	-12			
(U) Adjustments to Budget Year Since FY 1998 PB			-2,194	
(U) Current Budget Submit/ FY 1999 PB	7,412	3,786	2,663	

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

## (U) C. Other Program Funding Summary:

## (U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602202F, Armstrong Lab Exploratory Development.
- (U) PE 0602203F, Aerospace Propulsion.
- (U) PE 0603211F, Aerospace Structures.
- (U) PE 0603231F, Crew Systems and Personnel Protection Technology.
- (U) PE 0603716D, Strategic Environmental Research and Development Program.
- (U) PE 0604706F, Life Support Systems.
- (U) PE 0604708F, Other Operational Equipment.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

## (U) D. Schedule Profile: Not Applicable.

Project 2103

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Exhibit R-3 (PE 0603723F)

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PE NUMBER: 0603726F

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PE TITLE: C3 Subsystem Integration

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603726F C3 Subsystem Integration									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	8,167	9,364	11,025	11,295	6,606	6,722	6,901	Continuing	Continuing	
2810	Advanced Image/Information/Optical Memory Technology Applications	6,168	4,593	5,849	5,634	6,606	6,722	6,901	Continuing	Continuing	
2863	Integrated Photonics	1,999	4,771	5,176	5,661	0	0	0	0	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

Note: Beginning in FY 1998, Project 2810, Advanced Image/Information Applications, and Project 3192, Advanced Optical Memory Technology, were combined into Project 2810, Advanced Image/Information/Optical Memory Technology Applications, within this PE. The total PE cost shown for FY 1997 reflects this consolidation.

(U) A. **Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates Command, Control, and Communications (C3) technologies in the areas of processing and fusion of digital databases, photonics technology, optical disk storage/processing of digital information, and distributed processing technology for interoperability between dispersed command centers. These technologies provide increased storage, processing, and transmission of digital data received from a broad variety of sensors and sources. Note: In FY 1998 and out, additional emphasis has been placed on advanced subsystems integration and information warfare technologies to meet future user requirements.

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																																																							
BUDGET ACTIVITY		PE NUMBER AND TITLE																																																							
<b>3 - Advanced Technology Development</b>		<b>0603726F C3 Subsystem Integration</b>																																																							
<p>(U) B. <u>Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>8,390</td> <td>9,922</td> <td>10,566</td> <td>Cost</td> </tr> <tr> <td>(U) Appropriated Value</td> <td>8,777</td> <td>9,922</td> <td></td> <td>Cont</td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    a. Congressional/General Reductions</td> <td>-184</td> <td>-324</td> <td></td> <td></td> </tr> <tr> <td>    b. SBIR</td> <td>-203</td> <td>-234</td> <td></td> <td></td> </tr> <tr> <td>    c. Omnibus/Other Above Threshold Reprogrammings</td> <td>-209</td> <td></td> <td></td> <td></td> </tr> <tr> <td>    d. Below Threshold Reprogrammings</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    e. Rescissions</td> <td>-14</td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Other Adjustments to Budget Years Since FY 1998 PB</td> <td></td> <td></td> <td>459</td> <td></td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>8,167</td> <td>9,364</td> <td>11,025</td> <td>Cont</td> </tr> </tbody> </table>				FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	8,390	9,922	10,566	Cost	(U) Appropriated Value	8,777	9,922		Cont	(U) Adjustments to Appropriated Value					a. Congressional/General Reductions	-184	-324			b. SBIR	-203	-234			c. Omnibus/Other Above Threshold Reprogrammings	-209				d. Below Threshold Reprogrammings					e. Rescissions	-14				(U) Other Adjustments to Budget Years Since FY 1998 PB			459		(U) Current Budget Submit/FY 1999 PB	8,167	9,364	11,025	Cont
	FY 1997	FY 1998	FY 1999	Total																																																					
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<p>(U) Change Summary Explanation:  Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on Advanced Image/Information/Optical Memory technology applications within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																																																									
<p>(U) C. <u>Other Program Funding Summary:</u> Not Applicable.</p>																																																									
<p>(U) D. <u>Schedule Profile:</u> Not Applicable.</p>																																																									

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603726F C3 Subsystem Integration

2810

COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2810 Advanced Image/Information/Optical Memory Technology Applications	6,168	4,593	5,849	5,634	6,606	6,722	6,901	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** This project develops and demonstrates techniques and algorithms to meet weapon systems requirements for processed and fused multi-source information required for mission planning, navigation, targeting, and terrain analysis. It provides generic language translation processing techniques, and state-of-the-art algorithms for Air Force exploitation of digitally processed image and spatial (i.e., latitude, longitude, and elevation) database products, as well as develop automated capabilities to reference and display hypermedia (multi-media) information, and defensive information warfare technologies. This project also develops the erasable optical data storage systems with high capacity and fast input/output speed for fighter aircraft operation (to provide fast airborne access to mission-oriented data and the digital terrain system), and electronic surveillance aircraft (for on-board sensor data recording, operational mission planning requirements, large data storage requirements (i.e., high-volume, soft-copy, digital imagery exploitation)). Algorithms will be provided to automate the selection, and retrieval, and downloading of information stored on mass storage devices which are distributed across the data network. An array of optical disk drives will be developed for high throughput speed and fault-tolerant requirements. Three-dimensional (3-D) optical memory systems will be developed for volumetric digital data storage. This new mass storage technology will demonstrate ultra-high data density and fast, parallel data access within a low-cost, compact system.

Project 2810

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603726F C3 Subsystem Integration	2810	
(U) FY 1997 (\$ in Thousands):			
- (U) \$3,000	Developed and demonstrated advanced imagery information sensor fusion and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.		
	<ul style="list-style-type: none"><li>- (U) Conducted Phase 2 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access; demonstrated automated update of multiple heterogeneous data bases simultaneously to support interdisciplinary correlation and new information sources.</li><li>- (U) Developed a portable electronic information correlator for deployment with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield; conducted final demonstration at user's site of the enhanced, all-source, sensor fusion capability to locate, identify, and track mobile friend and foe (i.e., threats and targets) battlefield components.</li></ul>		
- (U) \$247	Demonstrated and delivered automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.		
	<ul style="list-style-type: none"><li>- (U) Demonstrated and delivered hypermedia algorithms for use with operational databases and navigational aid capabilities.</li><li>- (U) Demonstrated and delivered advanced hypermedia techniques for video indexing overlaps and links to connect secure information data bases.</li></ul>		
- (U) \$1,727	Developed and demonstrated optical information data handling, storage, and access technologies for strategic and tactical applications.		
	<ul style="list-style-type: none"><li>- (U) Fabricated pre-brassboard model of a three-dimensional (3-D) optical memory capable of storing 100 gigabytes of information and reconstructing it using a parallel optical readout technique; exploited virtual reality technology using digital data stored and accessed via 3-D optical memories.</li></ul>		
- (U) \$1,194	Designed, developed, and demonstrated optical disk and interface technologies which can be implemented in joint theater operations.		
	<ul style="list-style-type: none"><li>- (U) Completed the fabrication and demonstration of high-capacity Optical Jukebox interface with an information network.</li><li>- (U) Enhanced algorithm development and demonstrated the capability to select, retrieve, and store digital data from different sources and transfer such data to field units.</li></ul>		
- (U) \$6,168	Total		

Project 2810

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Exhibit R-2 (PE 0603726F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603726F C3 Subsystem Integration

2810

(U) FY 1998 (\$ in Thousands):

- (U) \$3,190 Develop and demonstrate advanced imagery information and spatial data base technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
- (U) Complete Phase 2 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access; demonstrate automated update of multiple heterogeneous data bases simultaneously to support interdisciplinary correlation and new information sources.
- (U) Continue development of the portable electronic information correlator for deployment with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield.
- (U) \$255 Develop and demonstrate automated capabilities to access, process, and display hypermedia (integrated text, imagery, audio, and video) information which fully exploit relationships between data available to the field commander in a timely manner.
- (U) Complete development of hypermedia algorithms for use with operational intelligence databases.
- (U) Develop advanced hypermedia techniques for collection, integration and dissemination of hypermedia for widespread use.
- (U) Develop information extraction technologies and capabilities to exploit data from unformatted text by automating the extraction and visualization process.
- (U) \$643 Develop and demonstrate optical information data handling, storage, and access technologies for strategic and tactical applications.
- (U) Deliver and demonstrate within an operational facility, a three-dimensional (3-D) optical memory using a write-once, read-many optical material.
- (U) Design a pre-brassboard model using a fully erasable 3-D optical material.
- (U) Design mass storage modules that integrate the benefits of 3-D optical memory with optical communication for instant access to multi-terabyte digital libraries.
- (U) \$505 Design, develop, and demonstrate optical disk and interface technologies which can be implemented in joint theater operations.
- (U) Deliver and evaluate search and retrieval algorithms for application to networked intelligence production facilities.
- (U) Develop a multi-layered optical disk technique for a ten-fold (10X) storage improvement.
- (U) Develop optical tape recording providing terabyte storage on a 12-inch reel for long-term, high-dense data retention applications.
- (U) \$4,593 Total

Project 2810

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development 0603726F C3 Subsystem Integration

2810

(U) FY 1999 (\$ in Thousands):

- (U) \$592 Develop and demonstrate advanced imagery information, sensor fusion, and spatial database technologies to enhance warfighter mission planning, navigation, targeting, and terrain analysis.
- (U) Conduct Phase 3 demonstration of multiple database integration and update capability to maintain a single uniform and current vector database for real-time access.
- (U) Design software algorithms which can be deployed with tactical communications systems to automatically correlate signal intelligence multisensor inputs on the battlefield.
- (U) Design an adaptive sensor fusion module and process controller to automatically correlate information regardless of the environment or source of sensor data.
- (U) \$1,729 Develop and demonstrate automated capabilities to access, process, and display intelligence and sensor data to improve the sensor exploitation process.
- (U) Design the capability to locate and harvest intelligence data stored in existing and future databases.
- (U) Design analytical software modules which provide decision options for warfighters located at geographically separated units.
- (U) Design information extraction technologies and capabilities to exploit data from unformatted text by automating the extraction and information visualization (i.e., battlesphere situational awareness) process.
- (U) \$2,507 Develop and demonstrate optical information data handling, storage, and access technologies for strategic and tactical applications.
- (U) Complete system design for a fully erasable three-dimensional (3-D) optical memory.
- (U) Complete design for an initial mass storage module providing a two-dimensional (2-D) optical filtering/correlation function.
- (U) \$330 Provides a high-speed associative search capability.
- (U) Design, develop, and demonstrate optical disk and interface technologies which can be implemented in joint theater operations.
- (U) Demonstrate a multi-layered optical disk system using an erasable phase change material for higher storage capacity and lower manufacturing costs.
- (U) Demonstrate an optical tape recorder/reader using a multi-laser beam design for a ten-fold (10X) improvement in data transfer speeds.
- (U) \$691 Design, develop, and demonstrate mission planning and rehearsal capabilities for theater battle management.
- (U) Design the capability to conduct semi-automated, objectives-based planning and assessment for Air Force and joint Command and Control (C2) requirements.
- (U) \$5,849 Total

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998															
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																
<b>3 - Advanced Technology Development</b>	<b>0603726F C3 Subsystem Integration</b>	<b>2810</b>																
<p>(U) <b>B. Program Change Summary (\$ in Thousands):</b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>6,262</td> <td>4,867</td> <td>5,286</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>6,168</td> <td>4,593</td> <td>5,849</td> <td>Cont</td> </tr> </tbody> </table>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	6,262	4,867	5,286	Cost	(U) Current Budget Submit/FY 1999 PB	6,168	4,593	5,849	Cont
	FY 1997	FY 1998	FY 1999	Total														
(U) Previous President's Budget (FY 1998 PB)	6,262	4,867	5,286	Cost														
(U) Current Budget Submit/FY 1999 PB	6,168	4,593	5,849	Cont														
<p>(U) Change Summary Explanation:            Funding: Changes in this project since the previous President's Budget are due to increased emphasis on Advanced Image/Information/Optical Memory technology applications within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p>																		
<p>(U) <b>C. Other Program Funding Summary:</b></p> <p>(U) Related Activities:</p> <ul style="list-style-type: none"> <li>- (U) PE 0602702F, Command, Control, and Communications (C3).</li> <li>- (U) PE 0603789F, C3 Advanced Development.</li> <li>- (U) PE 0603728F, Advanced Computing Technology.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) <b>D. Schedule Profile:</b> Not Applicable.</p>																		

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603726F C3 Subsystem Integration								2863	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2863	Integrated Photonics	1,999	4,771	5,176	5,661	0	0	0	0	TBD	

(U) A. Mission Description and Budget Item Justification: Current electronic systems are susceptible to electromagnetic interference, electromagnetic pulse, and radio frequency (RF) interference. Size constraints, speed, and reliability also limit traditional electronic systems. Photonics-based systems, which process information in the form of light (photon) signals, will provide major improvements in tactical and strategic Command, Control, and Communications (C3) systems by providing small-size, high-performance, high-capacity, survivable alternatives to electronic-based systems. This project develops and demonstrates advanced hardware technology in optical processing, adaptive transmission, and nonlinear optical processing.

(U) FY 1997 (\$ in Thousands):

- (U) \$162 Developed and demonstrated analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.
- (U) \$794 Began fabrication of a photonically interconnected Command, Control, and Communications (C3) processor for a technology demonstrator; demonstrated the advantages of photonic, high-speed agile processors in a variety of radar and communications functions.
- (U) \$1,043 Developed and tested laser resources for wide bandwidth optical processing and radio frequency (RF) systems.
- (U) \$1,999 Developed and demonstrated microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled RF systems at increased frequencies.
- (U) \$1,999 Conducted first stage development of 100 Gigahertz (GHz) RF photonic interconnect system extending the frequency and bandwidth of previous microwave link programs to support communications and surveillance.
- (U) \$1,043 Developed high frequency electro-optic modulators for use in high dynamic range, low noise RF systems.
- (U) \$1,043 Developed high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband, and anti-jam capabilities.
- (U) \$1,999 Began fabrication of a super high frequency (SHF) optically controlled phased array antenna.
- (U) \$1,999 Began design of an extremely high frequency (EHF) optically controlled phased array antenna with the agility needed for steering operational communications antennas.
- (U) \$1,999 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998										
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT											
<b>3 - Advanced Technology Development</b>	<b>0603726F C3 Subsystem Integration</b>	<b>2863</b>											
<p>(U) FY 1998 (\$ in Thousands):</p> <table><tbody><tr><td>- (U) \$1,261</td><td>Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.</td></tr><tr><td>- (U) \$1,385</td><td>- (U) Develop and transition laser sources, interconnect subsystems, and other key photonic components for wide bandwidth, high throughput, optical processing systems. Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.</td></tr><tr><td>- (U) \$2,125</td><td>- (U) Demonstrate high frequency electro-optic modulators, sources, and other photonic components for use in wide bandwidth, high dynamic range, low noise RF systems. Developed high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband, and anti-jam capabilities.</td></tr><tr><td>- (U) \$4,771</td><td>- (U) Complete fabrication and testing of a super high frequency (SHF) optically controlled phased array antenna. - (U) Complete design of an extremely high frequency (EHF) optically controlled phased array antenna with the agility needed for steering operational communications antennas.</td></tr><tr><td></td><td>Total</td></tr></tbody></table>				- (U) \$1,261	Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.	- (U) \$1,385	- (U) Develop and transition laser sources, interconnect subsystems, and other key photonic components for wide bandwidth, high throughput, optical processing systems. Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.	- (U) \$2,125	- (U) Demonstrate high frequency electro-optic modulators, sources, and other photonic components for use in wide bandwidth, high dynamic range, low noise RF systems. Developed high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband, and anti-jam capabilities.	- (U) \$4,771	- (U) Complete fabrication and testing of a super high frequency (SHF) optically controlled phased array antenna. - (U) Complete design of an extremely high frequency (EHF) optically controlled phased array antenna with the agility needed for steering operational communications antennas.		Total
- (U) \$1,261	Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.												
- (U) \$1,385	- (U) Develop and transition laser sources, interconnect subsystems, and other key photonic components for wide bandwidth, high throughput, optical processing systems. Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.												
- (U) \$2,125	- (U) Demonstrate high frequency electro-optic modulators, sources, and other photonic components for use in wide bandwidth, high dynamic range, low noise RF systems. Developed high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband, and anti-jam capabilities.												
- (U) \$4,771	- (U) Complete fabrication and testing of a super high frequency (SHF) optically controlled phased array antenna. - (U) Complete design of an extremely high frequency (EHF) optically controlled phased array antenna with the agility needed for steering operational communications antennas.												
	Total												

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603726F C3 Subsystem Integration	2863	
(U) FY 1999 (\$ in Thousands):			
-(U) \$1,421	Develop and demonstrate analog and digital optical processing technologies to provide real-time data for pre- and post-mission analysis, as well as sensor integration and automatic target identification using multispectral surveillance systems.		
	- (U) Develop optical micro-networks appropriate for use in high-speed processors for air and space platforms.		
	- (U) Integrate, test, and transition laser sources, interconnect subsystems, and other key photonic components for wide bandwidth, high throughput, optical processing systems onto airborne high performance computers.		
-(U) \$1,500	Develop and demonstrate microwave/millimeter-wave photonics processing and subsystems for advanced optically-controlled radio frequency (RF) systems at increased frequencies.		
	- (U) Begin design of a dynamically reconfigurable radio frequency signal distribution system for use on air and space platforms.		
	- (U) Test and integrate into airborne RF sensor and countermeasure systems high frequency electro-optic modulators, sources, and other photonic components.		
-(U) \$2,255	Develop high performance control systems for RF phased array antennas providing extremely wide angle coverage, broadband, and anti-jam capabilities.		
	- (U) Complete transition of a super high frequency (SHF) optically controlled phased array antenna onto airborne command and control platforms for satellite communications.		
	- (U) Begin fabrication phase of an extremely high frequency (EHF) optically controlled phased array antenna with the agility needed for steering operational satellite communications antennas		
-(U) \$5,176	Total		

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Exhibit R-2 (PE 0603726F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT																				
BUDGET ACTIVITY	PE NUMBER AND TITLE																						
<b>3 - Advanced Technology Development</b>	<b>0603726F C3 Subsystem Integration</b>		<b>2863</b>																				
<p>(U) <u>B. Program Change Summary (\$ in Thousands):</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY 1998 PB)</td> <td>2,128</td> <td>5,055</td> <td>5,280</td> <td>Cost</td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 PB</td> <td>1,999</td> <td>4,771</td> <td>5,176</td> <td>Cont</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>TBD</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation: Funding: Changes in this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&amp;T) Program.</p> <p>Schedule: Not Applicable.</p> <p>Technical: Not Applicable.</p> <p>(U) <u>C. Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> <li>- (U) PE 0602702F, Command, Control, and Communications (C3).</li> <li>- (U) PE 0603789F, C3 Advanced Development.</li> <li>- (U) PE 0603728F, Advanced Computing Technology.</li> <li>- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.</li> <li>- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul> <p>(U) <u>D. Schedule Profile:</u> Not Applicable.</p>					FY 1997	FY 1998	FY 1999	Total	(U) Previous President's Budget (FY 1998 PB)	2,128	5,055	5,280	Cost	(U) Current Budget Submit/FY 1999 PB	1,999	4,771	5,176	Cont					TBD
	FY 1997	FY 1998	FY 1999	Total																			
(U) Previous President's Budget (FY 1998 PB)	2,128	5,055	5,280	Cost																			
(U) Current Budget Submit/FY 1999 PB	1,999	4,771	5,176	Cont																			
				TBD																			

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PE NUMBER: 0603728F

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PE TITLE: Advanced Computer Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603728F Advanced Computer Technology									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
	Total Program Element (PE) Cost	7,558	5,270	7,827	8,050	8,082	8,321	8,535	Continuing	Continuing	
2527	Software Life Cycle Tools	2,087	1,092	2,289	2,343	2,354	2,401	2,466	Continuing	Continuing	
2530	Distributed Systems Reliability and Survivability	2,384	1,560	2,407	2,462	2,472	2,535	2,603	Continuing	Continuing	
2532	Knowledge-Based Systems	3,087	2,618	3,131	3,245	3,256	3,385	3,466	Continuing	Continuing	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

(U) **A. Mission Description and Budget Item Justification:** This Advanced Technology Development program develops and demonstrates technologies needed to control cost, reduce risk, and increase efficiency and effectiveness of software and computers required for Air Force mission critical combat systems. The Air Force has experienced a dramatic escalation in the cost of acquiring and maintaining embedded computer software for increasingly complex military systems which must be reliable and survivable in the battlefield environment. The requirement for survivable tactical and strategic computing systems has driven the need for automatic integration and interoperability of multiple processing elements, automatic redistribution of data and functions, and location-independent access to data. Distributed processing techniques, which can dynamically reconfigure Command, Control, Communications, and Computer (C4) systems to accommodate lost components or nodes, are required to ensure survivable mission critical command and control functions. Note: In FY 1999 and out, additional emphasis has been placed on advanced computer technologies to meet future user requirements.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603728F Advanced Computer Technology

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget (FY 1998 PB)	8,089	5,613	6,684	
(U) Appropriated Value	8,509	5,613		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-219	-214		
b. SBIR	-201	-129		
c. Omnibus/Other Above Threshold Reprogrammings	-518			
d. Below Threshold Reprogrammings				
e. Rescissions	-13			
(U) Other Adjustments to Budget Years Since FY 1998 PB			1,143	
(U) Current Budget Submit/FY 1999 PB	7,558	5,270	7,827	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on Advanced Computer technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) D. Schedule Profile: Not Applicable.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603728F Advanced Computer Technology

2527

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2527 Software Life Cycle Tools	2,087	1,092	2,289	2,343	2,354	2,401	2,466	Continuing	Continuing

(U) A. **Mission Description and Budget Item Justification:** Advanced computer systems in Air Force weapon systems require software life cycle tools and technology to reduce costs, improve quality, and enhance productivity. This project develops, evaluates, and transitions new software technology that reduces cost, while improving software, systems, and productivity factors. It develops software life cycle support environments which incorporate both laboratory and commercial off-the-shelf (COTS) products. This project provides a vehicle for software technology integration, transition, and evaluation under operational and field conditions. Technologies for system requirements analysis, reuse of software components, software quality specification, measurement, assessment, and high performance (parallel) computer software engineering are also produced.

## (U) FY 1997 (\$ in Thousands):

- (U) \$655 Designed, developed, tested, and demonstrated technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, dynamic programming languages, and formal methods for defining, analyzing, and assessing evolutionary systems.
- (U) Completed final demonstrations of network-oriented software support environments which emphasize affordability and software reuse certification technologies and provided this capability to the user.
- (U) Designed technologies for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages. Combined with an integrated approach for dealing with system requirements and documentation.
- (U) Designed open-systems technology for evolving software systems which are compatible with the commercial international network. Developed and demonstrated advanced software technologies to provide the user the means to analyze operational software requirements.
- (U) Completed the development performance modeling aspect of the Block 1 advanced requirements analysis workstation.
- (U) Based on industry comments, user feedback, and the need for addressing operational software requirements analysis, completed an assessment of the operational requirements analysis/workstation.
- (U) \$292 Developed and demonstrated software quality enhancements through automated tools and methods.
- (U) Completed case studies for software quality technology demonstration; provided third increment of repository software information.
- (U) \$520 Developed high performance advanced parallel computer software and architecture for weapon and information systems applications.
- (U) Developed and tested software upgrades to the Parallel Assessment Window System to provide a "user friendly" interface for adding new architectures and execution criteria. Efforts were focused on capabilities to define emerging parallel architectures and methods for comparing execution profiles.
- (U) Completed development efforts on the architecture-independent parallel design tool and demonstrated it on advanced parallel computer systems.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603728F Advanced Computer Technology	2527	
- (U) \$2,087	- (U) Completed design and development of methods for integrating and demonstrating component level software technology for parallel computing systems for "typical" Air Force Command, Control, Communications and Intelligence (C3I) problem domains.		
- (U) \$2,087	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$561	Design, develop, test, and demonstrate technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, and formal methods for defining, analyzing, and assessing evolutionary systems.		
- (U) \$273	- (U) Develop and test technology for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages. Combine with an integrated approach for dealing with system requirements and documentation and implement using the existing systems engineering framework.		
- (U) \$258	- (U) Develop and test open-systems technology for evolving software systems which are compatible with the commercial international network technology and which enhance life cycle costs of Air Force software intensive systems. Efforts will focus on component level capabilities for design rationale, capture, and architecture based framework implementation.		
- (U) \$1,092	- (U) Complete the effort to optimize parallel computer software and architecture for weapon and information system applications. capabilities on heterogeneous systems made up of commercial-off-the-shelf (COTS) technology and specialized weapon system hardware/software.		
- (U) \$1,147	- (U) Complete methods for integrating and demonstrating parallel computing systems software technology for "typical" Air Force C3I problem domains.		
- (U) \$1,092	Design, develop, and demonstrate technology for the exploitation of easily changeable software (dynamic languages) that provides flexibility to speed up the design and change process.		
- (U) \$1,092	- (U) Design the capability to integrate program code of dynamic and static languages (not easily changed once compiled) within the same module, and to incrementally generate code.		
- (U) \$1,092	- (U) Design dynamic languages and software development support tools that are as efficient as static languages and meet military performance constraints.		
- (U) \$1,092	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$1,147	Design, develop, test, and demonstrate technology for the capture and exploitation of information for building evolutionary systems, capabilities to model and analyze complex systems, and formal methods for defining, analyzing, and assessing evolutionary systems.		
- (U) \$1,147	- (U) Demonstrate technology for packaging diverse software capabilities such as visualization, hyper-programming, dynamic testing, and object-oriented languages. Combine with an integrated approach for dealing with system requirements and documentation and implement using the existing systems engineering framework.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603728F Advanced Computer Technology	2527	
- (U) \$872	- (U) Demonstrate open-systems technology for evolving software systems which are compatible with the commercial international network technology and which enhance life cycle costs of Air Force software intensive systems. Efforts will focus on component level capabilities for design rationale, capture, and architecture based framework implementation. Design, develop, and demonstrate technology to mathematically represent, analyze, and assess complex software systems and their architectures to enhance software quality and validity.		
- (U) \$270	- (U) Develop and test the ability to mathematically represent architectural, functional, and Quality of Service (safety, performance, reliability, security, fault tolerance, etc.) properties to enable automatic design analysis and performance evaluation of software systems. - (U) Design analytical methods for monitoring system Quality of Service parameters; design requirement assumptions; and testing quality of software systems. Design, develop, and demonstrate technology for the exploitation of easily changeable software (dynamic languages) that provides flexibility to speed up the design and change process.		
- (U) \$2,289	- (U) Develop and test the capability to integrate program code of dynamic and static languages (not easily changed once compiled) within the same module, and to incrementally generate code. - (U) Develop and test dynamic languages and software development support tools that are as efficient as static languages and meet military performance constraints.		
	Total		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603728F Advanced Computer Technology	2527	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	2,438	1,167	1,687
	2,087	1,092	2,289
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on Advanced Computer technologies within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0604740F, Computer Resource Management.			
- (U) PE 0701112F, Inventory Control Point Operation.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603728F Advanced Computer Technology								2530	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2530	Distributed Systems Reliability and Survivability	2,384	1,560	2,407	2,462	2,472	2,535	2,603	Continuing	Continuing	

(U) A. Mission Description and Budget Item Justification: This project develops software technology to provide the distributed computer information handling for future Command, Control, Communications, and Computer (C4) systems. These technologies integrate numerous heterogeneous processing networks and provide secure, seamless access to information. Future C4 systems must be reconfigurable, operate in real-time, and be survivable, as well as capable of integrating the full spectrum of multimedia data. These systems will operate in an "information pull" mode where the users' requests for information are filled without explicit action on the part of the user to locate, retrieve, or merge data. An object-oriented architecture provides a common perspective which integrates the communications control system and the distributed computing environment.

(U) FY 1997 (\$ in Thousands):

- (U) \$856 Developed and demonstrated heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
- (U) Developed the integration of security mechanisms into multi-networked distributed computing environments.
- (U) Developed the ability to establish a distributed computing environment across a limited bandwidth interconnection.
- (U) Integrated mobile computing nodes into a heterogeneous distributed computing environment.
- (U) \$757 Developed and demonstrated database management techniques for managing multimedia data in distributed information systems.
- (U) Developed artificial intelligent agents for retrieval of multimedia data across a wide area network.
- (U) Integrated speech as a managed object in an object-based, distributed, multimedia database management system.
- (U) Developed multimedia database management across multiple locally netted computers.
- (U) \$771 Developed real-time adaptive distributed computing environments to support crisis management and survivability.
- (U) Developed an adaptive reconfigurable distributed computing environment based upon an application-derived parameter.
- (U) Developed real-time distributed computing architecture across heterogeneous networks for tracking.
- (U) Developed dynamic process and data migration across a multi-networked distributed information system.
- (U) \$2,384 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 3 - Advanced Technology Development

PE NUMBER AND TITLE

0603728F Advanced Computer Technology

PROJECT

2530

## (U) FY 1998 (\$ in Thousands):

- (U) \$780 Develop and demonstrate heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
- (U) Demonstrate utility of security mechanisms integrated into multi-networked distributed computing environments.
- (U) Test the design of a distributed computing environment across a limited bandwidth connection.
- (U) Test the design of mobile computing nodes in a heterogeneous distributed computing environment.
- (U) \$327 Develop and demonstrate distributed database management techniques for managing multimedia data in distributed information systems.
- (U) Test the artificial intelligent design for retrieval of multimedia data across a wide area network.
- (U) Integrate video as a managed object in an object-based, distributed, multimedia database management system.
- (U) Test the design of multimedia database management across multiple locally netted computers.
- (U) \$453 Develop real-time adaptive distributed computing environments to support crisis management and survivability.
- (U) Test the adaptive reconfigurable distributed computing environment design based upon an application-derived parameter.
- (U) Test the design of a real-time distributed computing architecture across heterogeneous networks for tracking.
- (U) Demonstrate dynamic process and data migration across a multi-networked distributed information system.
- (U) \$1,560 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$1,235 Develop and demonstrate heterogeneous, secure, multi-networked distributed computing environments for interoperability and survivability.
- (U) Integrate information warfare technologies into multi-networked distributed computing environments.
- (U) Demonstrate the ability of a distributed computing environment to adapt to a limited bandwidth (low-speed) interconnection.
- (U) Demonstrate the ability to dynamically and autonomously reconfigure the distributed network for mobile computing nodes in a heterogeneous distributed computing environment.
- (U) Demonstrate reliability, availability, performance, and resource management across distributed sets of nodes.
- (U) \$532 Develop and demonstrate distributed database management techniques for managing multimedia data in distributed information systems.
- (U) Demonstrate the utility of artificial intelligent agents for the retrieval of multimedia data across a wide area network.
- (U) Demonstrate the integration of audio/video/data as a managed object in an object-based, distributed, multimedia database management system.
- (U) Demonstrate multimedia database management across multiple wide-area networked computers.
- (U) \$640 Develop real-time adaptive distributed computing environments that support crisis management and survivability.
- (U) Demonstrate a reconfigurable distributed computing environment based upon external parameters (i.e., network configuration, user/mission needs, operational environment) as well as multiple application-derived parameters.
- (U) Demonstrate real-time distributed computing architecture across heterogeneous networks.

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Exhibit R-2 (PE 0603728F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603728F Advanced Computer Technology</b>	<b>2530</b>	
- (U) Develop the capability to move processes and data across a multi-networked distributed information system. - (U) \$2,407 Total			
<b>(U) B. <u>Program Change Summary (\$ in Thousands):</u></b>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	2,492	1,674	2,028
	2,384	1,560	2,407
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation: Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on Advanced Computer technologies within the Science and Technology (S&T) Program.  Schedule: Not Applicable.  Technical: Not Applicable.			
<b>(U) C. <u>Other Program Funding Summary:</u></b>			
(U) <u>Related Activities:</u>			
- (U) PE 0604740F, Computer Resource Management.			
- (U) PE 0701112F, Inventory Control Point Operation.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
<b>(U) D. <u>Schedule Profile:</u></b> Not Applicable.			

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Exhibit R-2 (PE 0603728F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
DATE February 1998									
PROJECT 2532									
BUDGET ACTIVITY									
PE NUMBER AND TITLE									
0603728F Advanced Computer Technology									
3 - Advanced Technology Development									
COST (\$ In Thousands)									
	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2532 Knowledge-Based Systems	3,087	2,618	3,131	3,245	3,256	3,385	3,466	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: Knowledge-based computer systems provide the capability to automatically solve reasoning problems. This effort develops computer technologies which automate the problem solving process associated with human thought. It has three major thrusts. The first, knowledge-based analysis, provides software tools and techniques to develop and evaluate knowledge-based intelligent information tools to support robust, real-time, large-scale information systems. The second, knowledge-based planning, applies artificial intelligence (AI) technology to provide increased cost-effectiveness in diverse planning applications such as air operations planning and execution management, employment and deployment planning, logistics planning, resource allocation, and scheduling processes. The third, knowledge-based software techniques, exploits knowledge-based methods to achieve major improvements in software development and support activities.

(U) FY 1997 (\$ in Thousands):

- (U) \$210 Developed and demonstrated knowledge-based software analysis technologies to support robust, real-time, large-scale information systems.
- (U) \$1,507 Developed high level tools and methodology facilitating the evolution, evaluation, and integration of information sources for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
- (U) \$1,370 Developed and demonstrated knowledge-based technologies to automate labor-intensive tasks to allow rapid, accurate, and efficient planning.
- (U) \$3,087 Completed development schedule planning and scheduling tools for real-time operational use for strategic airlift.
- (U) \$3,087 Completed artificial intelligence planning and scheduling tools for imprecise environments.
- (U) \$3,087 Demonstrated generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
- (U) \$3,087 Demonstrated strategies for efficient planning scenario generation in various military domains.
- (U) \$3,087 Demonstrated knowledge-based technologies that support the evolution and adaptation of software systems.
- (U) \$3,087 Completed Knowledge-Based Software Assistant (KBSA) advanced development model, supporting process representation, configuration management, text generation, instrumentation, and project management. Evaluated in a mission critical application.
- (U) \$3,087 Developed knowledge-based evolutionary design tools for software and system development.
- (U) \$3,087 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603728F Advanced Computer Technology	2532	

(U) FY 1998 (\$ in Thousands):

- (U) \$241	Develop and demonstrate knowledge-based technologies to support active robust, real-time, large-scale intelligent information systems.
	- (U) Test systematic tools and evaluation methodology for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.
	- (U) Develop knowledge-based acquisition tools to guide users in augmenting systems and deriving knowledge for large quantities of distributed data for active information systems.
- (U) \$1,916	Develop and demonstrate knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.
	- (U) Develop the test plan and feasibility estimation for both planning and monitoring of joint air campaigns.
	- (U) Test artificial intelligence planning and scheduling tools for imprecise environments.
	- (U) Integrate generative planning and intelligent automated assistance for both planning and monitoring of joint air campaign.
	- (U) Test strategies for efficient planning scenario generation in various military domains.
- (U) \$461	Develop knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.
	Develop and demonstrate knowledge-based technologies that support the evolution and adaptation of software systems.
	- (U) Test knowledge-based evolutionary design tools for software and system development in military applications.
	- (U) Develop knowledge-based acquisition capabilities that assist in monitoring and evaluating the satisfaction and capture of requirements and rationale for software systems.
- (U) \$2,618	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development		0603728F Advanced Computer Technology	
(U) FY 1999 (\$ in Thousands):			
- (U) \$490	Develop and demonstrate knowledge-based technologies to support active, robust, real-time warfighting applications for large-scale intelligent information systems.		
	- (U) Integrate systematic tools and evaluation methodology for collaborative intelligent information systems capable of coordination, cooperation, and negotiation.		
	- (U) Test tools for the acquisition of knowledge bases that support active information systems. These tools will guide users in augmenting systems and deriving knowledge for large quantities of distributed data.		
	- (U) Develop collaborative decision-based and knowledge-based agents for large-scale information systems.		
	- (U) Develop information system techniques to support real-time large-scale dynamic data mining		
- (U) \$1,834	Develop and demonstrate knowledge-based technologies for planning in large imprecise environments.		
	- (U) Demonstrate feasibility estimation techniques for both planning and monitoring of joint air campaigns.		
	- (U) Demonstrate artificial intelligence planning and scheduling tools for imprecise environments.		
	- (U) Complete flexible planning and automated domain-expert assistance for both planning and monitoring the joint air campaign.		
	- (U) Demonstrate strategies for efficient planning scenario generation in various military domains.		
	- (U) Test knowledge-based technologies in continuous planning to allow rapid, accurate, and efficient plan generation.		
	- (U) Develop planning and information-based agents for adaptive re-planning for large-scale military systems		
	- (U) Develop tools for man/machine collaborative advisable planning and visual demonstration including distributed planning cells.		
- (U) \$807	Develop Artificial Intelligence/Operations Research (AI/OR) conceptual modeling tools for planning information-based systems.		
	Develop and demonstrate knowledge-based technologies that support the evolution and adaptation of software systems.		
	- (U) Demonstrate knowledge-based evolutionary design tools for software and system development in military applications.		
	- (U) Test knowledge-based acquisition capabilities that assist monitoring and evaluating the quality of requirements generation, as well as capturing these requirements and rationale during software development.		
- (U) \$3,131	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

3 - Advanced Technology Development

0603728F Advanced Computer Technology

2532

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)  
 (U) Current Budget Submit/FY 1999 PB

	FY 1997	FY 1998	FY 1999	Total
	3,159	2,772	2,969	Cost
	3,087	2,618	3,131	Cont

## (U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to increased emphasis on Advanced Computer technologies within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:(U) Related Activities:

- (U) PE 0604740F, Computer Resource Management.
- (U) PE 0701112F, Inventory Control Point Operation.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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PE NUMBER: 0603789F

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PE TITLE: C3 Advanced Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
3 - Advanced Technology Development		0603789F C3 Advanced Development									
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		11,283	12,865	13,235	13,645	15,651	15,527	15,884	Continuing	Continuing	
2335	Advanced C3 Technology	4,120	5,069	4,038	4,167	5,263	5,191	5,312	Continuing	Continuing	
4072	Correlation and Fusion	4,983	6,453	6,804	6,975	7,697	7,594	7,759	Continuing	Continuing	
4216	Warfighter Information Usage, Management, and Integration Technologies	2,180	1,343	2,393	2,503	2,691	2,742	2,813	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

Note: Beginning in FY 1998, PE 0603238F, Global Surveillance and Communications, has been incorporated as Project 4216, Warfighter Information Usage, Management, and Integration Technologies, within this PE. The total PE cost shown for FY 1997 reflects this consolidation.

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program develops and demonstrates ground and aerospace Command, Control, and Communications (C3) technology required to maintain Air Force capabilities in a fast-paced, sophisticated, high threat, and intense jamming environment. Enhanced surveillance and communications technology must be developed to counteract an enemy's jamming and to restore critical communications links to the warfighter. The technologies developed in this program include detection, identification, and tracking of hostile targets at long ranges on Command and Control (C2) and Intelligence platforms under combat conditions. Additionally, this project develops reliable, secure, jam-resistant communications, and battle management technology that supports the military leader's combat decisions in response to the changing dynamics of the battlefield. Note: In FY 1999 and out, additional emphasis has been placed on C3 technologies and correlation and fusing technologies to meet future user requirements.

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Exhibit R-2 (PE 0603789F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY		PE NUMBER AND TITLE
<b>3 - Advanced Technology Development</b>		<b>0603789F C3 Advanced Development</b>
February 1998		
(U) <u>B. Program Change Summary (\$ in Thousands):</u>		
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998
(U) Appropriated Value	12,580	12,897
(U) Adjustments to Appropriated Value	13,188	13,647
a. Congressional/General Reductions		
b. SBIR	-319	-483
c. Omnibus/Other Above Threshold Reprogrammings	-289	-299
d. Below Threshold Reprogrammings	-1,138	
e. Rescissions	-138	
(U) Other Adjustments to Budget Years Since FY 1998 PB	-21	
(U) Current Budget Submit/FY 1999 PB	11,283	12,865
		-266
		13,235
		Cont
(U) Change Summary Explanation:		
Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.		
Schedule: Not Applicable.		
Technical: Not Applicable.		
(U) <u>C. Other Program Funding Summary:</u> Not Applicable.		
(U) <u>D. Schedule Profile:</u> Not Applicable.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603789F C3 Advanced Development								2335	
COST (\$ in Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2335	Advanced C3 Technology	4,120	5,069	4,038	4,167	5,263	5,191	5,312	Continuing	Continuing	

**(U) A. Mission Description and Budget Item Justification:** This project develops Command, Control, and Communications (C3) technology for contingency and joint operations focusing on the concepts of force deployment, sustainment, and employment. Dynamic, hostile battlefield environments demand near instantaneous transmission and processing of vast amounts of C3 information for real-time decision making. This project develops and integrates technologies for: low probability of intercept/anti-jam transmission; modular, programmable, multi-level secure communications; secure survivable networks; advanced displays and interfaces; and battle management decision support capabilities for survivable, distributed Command and Control (C2) facilities. Multiband/multimode programmable radios will be enhanced to address the transmission link requirements of joint combat theater communications. Note: During FY 1997, the Defensive Planning and Execution (DPE) program was renamed the Joint Defensive Planner (JDP) per the Joint Standards Air Operations Software Configuration Control Board. The board designated DPE as the joint-Services software application for theater air and missile defensive planning and monitoring.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$2,267 Developed and demonstrated critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.
- (U) Demonstrated SPEAKEasy (Phase-2) Model-1 equipment in support of the 11th Air Support Operations Squadron (ASOS) Tactical Air Control Party (TACP) during Task Force XXI Air Warfighter Experiment at Ft. Irwin, CA.
- (U) Demonstrated SPEAKEasy on high frequency (HF), very high frequency (VHF), and ultra high frequency (UHF) communication bands operating in Single-Side-Band, amplitude modulated (AM), frequency modulated (FM), Single Channel Ground and Airborne Radio System (SINCGARS) and Have Quick (hopping and nonhopping) modes.
- (U) Demonstrated open modular hardware, software reprogrammability, and voice-bridging of dissimilar radios.
- Demonstrated advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.
- (U) Based on revised specification, developed, integrated, and field-tested management system survivability and security features for survivable Asynchronous Transfer Mode (ATM) in an existing standards-based management platform system.
- (U) Established under the survivable ATM effort, baseline network management system requirements for military quality-of-service, survivability, and performance measures.
- (U) Developed for survivable ATM, a standard network management system interface allowing seamless interoperability with other standards-based military and commercial systems.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>3 - Advanced Technology Development</b>	<b>0603789F C3 Advanced Development</b>	<b>2335</b>	
- (U) \$1,093	Demonstrated theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.		
- (U)	- (U) Demonstrated the completed operations and surveillance integration brassboard designs; completed preliminary/final acceptance test in an operational environment; and hosted the operations and surveillance integration brassboard technology demonstration to the user.		
- (U)	- (U) Completed final acceptance tests on an integrated information management capability for the Air Operations Center. Conducted the Operations/Intelligence Integration brassboard technology demonstration to the user.		
- (U)	- (U) Developed user coordinated concept plan for developing an air Joint Defensive Planner (JDP) brassboard which integrates the use of air and ground surveillance and weapon systems assets; designed algorithms and paradigms to support an automated functional process.		
- (U) \$4,120	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$2,104	Develop and demonstrate critical ground and aerospace communications technology advances in programmable devices and monolithic microwave integrated circuits to provide survivable radios and transceivers.		
- (U) \$2,353	- (U) Demonstrate benefits and capabilities of Phase 2 SPEAKeasy system employing an advanced radio-frequency (with co-site mitigation) and smart radio functions in field tests.		
- (U)	Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.		
- (U)	- (U) Develop an integrated (theater level) self-healing network capability.		
- (U)	- (U) Demonstrate integrated protocols and network management capability for survivable Asynchronous Transfer Mode (ATM) on standards-based platforms.		
- (U) \$612	- (U) Enhance and expand the deployability of the survivable ATM demonstration system.		
- (U)	Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.		
- (U) \$5,069	- (U) Implement a limited brassboard capability for JDP. Employ the baseline capability to test and demonstrate knowledge-based decision support and artificial intelligence tools to facilitate automated JDP capabilities.		
- (U)	Total		

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE <b>February 1998</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
<b>3 - Advanced Technology Development</b>	<b>0603789F C3 Advanced Development</b>	<b>2335</b>
(U) FY 1999 (\$ in Thousands):		
- (U) \$1,802	Develop and demonstrate programmable devices and monolithic microwave integrated circuit technology in survivable radios and transceivers for critical ground and aerospace communications.	
- (U) \$1,481	<ul style="list-style-type: none"> <li>- (U) Determine wideband performance limitations for SPEAKeasy terminal (bus and processor stressing conditions).</li> <li>- (U) Initiate an Advanced Technology Demonstration (ATD) for a smart networked radio.</li> </ul>	
- (U) \$755	<ul style="list-style-type: none"> <li>- (U) Demonstrate advanced networking technologies to provide efficient, secure, interoperable, and deployable communications systems.</li> <li>- (U) Demonstrate dynamic integrated self-healing networking, incorporating mobile ground/air communications elements, tactical ground elements, and satellite capability.</li> </ul>	
- (U) \$4,038	<ul style="list-style-type: none"> <li>- (U) Demonstrate theater battle management and time-critical air operations technologies to provide field commanders essential operational decision support and rapid response capabilities.</li> <li>- (U) Complete implementation of the limited brassboard capability and host the Joint Defensive Planner (JDP) advanced technology demonstration to the user.</li> </ul>	
	Total	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
3 - Advanced Technology Development	0603789F C3 Advanced Development	February 1998	2335
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999
(U) Current Budget Submit/FY 1999 PB	4,265	4,636	4,119
	4,120	5,069	4,038
			Total
			Cost
			Cont
			Cont
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) Related Activities:			
- (U) PE 0603617F, C3 Applications.			
- (U) PE 0603737D, Advanced Research Projects Agency.			
- (U) PE 0603006A, C3 Technology.			
- (U) PE 0602702F, Command, Control, and Communications (C3).			
- (U) PE 0602232N, C3 Technology.			
- (U) PE 0603726F, C3 Subsystem Integration.			
- (U) PE 0603728F, Advanced Computing Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT		
3 - Advanced Technology Development		0603789F C3 Advanced Development								4072		
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
4072	Correlation and Fusion	4,983	6,453	6,804	6,975	7,697	7,594	7,759	Continuing	Continuing		

(U) A. Mission Description and Budget Item Justification: In order to ensure maximum target engagement ranges and a first-shot, first-kill capability, the Air Force must be able to detect, positively identify, and track hostile targets. This project develops and demonstrates sensor processing techniques, track and fusion algorithms, bistatic sensor technologies, and correlation techniques in order to enhance target detection and tracking ranges. This project develops and integrates the necessary suite of complementary passive and active hostile target identification technologies for command and control platforms. These technologies will enhance the performance of identification and threat assessment systems for improved acquisition, tracking, and target engagement ranges for theater operations.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

## 3 - Advanced Technology Development

0603789F C3 Advanced Development

PROJECT

4072

## (U) FY 1997 (\$ in Thousands):

- (U) \$2,313 Developed and demonstrated advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
- (U) Completed installation of multi-sensor integration algorithm on an operational surveillance platform and demonstrated on-board and off-board platform sensor fusion and integration.
- (U) Completed bench testing of active radar identification technologies on-board an operational surveillance platform for a FY 1999 demonstration and test.
- (U) Developed preliminary acoustic analysis algorithms to passively identify hostile targets for FY 2000 demonstration.
- (U) \$742 Developed and demonstrated advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
- (U) Completed ground-based evaluations of the 64-channel bistatic ground testbed capability and identified areas which require further development to reduce technical risks of future airborne bistatic technology demonstrations.
- (U) Completed the design of an airborne bistatic testbed.
- (U) \$1,928 Developed and demonstrated advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.
- (U) Completed evaluations of high performance computer parallel processing technology applications which employ real-time cueing and correlation techniques to enhance wide area surveillance, time-critical-target detection and tracking.
- (U) Conducted initial field demonstration tests of a real-time signal processor enhancement which performs sensory management and enhanced/inverse synthetic aperture radar algorithm functions on an operational systems testbed.
- (U) \$4,983 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$2,816 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile airborne targets using multiple off-board sensors.
- (U) Develop and assess first generation intelligent techniques that exploit the inherent heuristic knowledge of an operator's cognitive process to pro-actively assimilate dynamic track and intelligence data with a-priori static databases.
- (U) Integrate active radar identification technology on-board an operational surveillance platform.
- (U) \$940 Develop and assess second generation acoustic analysis algorithms to passively identify hostile targets.
- (U) Develop and demonstrate advanced passive sensor technologies and concepts for increased survivability of fielded systems and assured detection and tracking of combat threats.
- (U) Integrate and test bistatic airborne testbed.
- (U) \$2,697 Develop and demonstrate advanced sensor technologies and concepts for assured detection and tracking of hostile ground targets using multiple off-board sensors.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

### 3 - Advanced Technology Development

**0603789F C3 Advanced Development**

## PROJECT

4072

- (U) Develop a preliminary real-time airborne design concept which demonstrates the use of all source advanced correlation capability for the detection and tracking of time-critical-targets.
- (U) Complete test and demonstration of real-time signal processor enhancement hardware running algorithms on operational systems testbed.

— (U) \$6,453 Total

(U) FY 1999 (\$ in Thousands):

—	(U) \$2,998	Develop and demonstrate advanced sensor technologies and concepts for assured detection, tracking, and identification of hostile airborne targets using multiple off-board sensors.
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- (U) Develop and assess second generation intelligent techniques that assist operators in identifying tracks and targets.
- (U) Complete integration of active radar identification technology on-board an operational surveillance platform.
- (U) Develop and evaluate third generation acoustic analysis algorithms for passively identifying hostile targets via an intelligence collection platform.

— (U) \$964 Develop and demonstrate advanced passive sensor technologies and concepts that increase the survivability of fielded systems by quietly detecting and tracking combat threats.

- (U) Complete bistatic airborne testbed integration and test.

— (U) \$2,842 Develop and demonstrate advanced sensor technologies and concepts for assured detection, tracking, and identification of hostile ground targets using multiple off-board sensors.

- (U) Continue design of real-time airborne demonstration of all source advanced correlation capability for the detection and tracking of time-critical targets.

- (U) Develop teraflop signal processor technology for existing and future operational surveillance platform applications.

**Total**  
**— (U) \$6,804**

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
3 - Advanced Technology Development	0603789F C3 Advanced Development	4072	
(U) B. <u>Program Change Summary (\$ in Thousands):</u>			
(U) Previous President's Budget (FY 1998 PB)		FY 1997	
(U) Current Budget Submit/FY 1999 PB		6,124	
		4,983	
		FY 1998	FY 1999
		6,841	6,941
		6,453	6,804
		Total	
		Cost	
		Cont	
		Cont	
(U) Change Summary Explanation:			
Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.			
Schedule: Not Applicable.			
Technical: Not Applicable.			
(U) C. <u>Other Program Funding Summary:</u>			
(U) <u>Related Activities:</u>			
- (U) PE 0603203F, Advanced Avionics for Aerospace Vehicles.			
- (U) PE 0602702F, Command, Control, and Communications (C3).			
- (U) PE 0603742F, Combat Identification Technology.			
- (U) PE 0603726F, C3 Subsystem Integration.			
- (U) PE 0603728F, Advanced Computing Technology.			
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.			
(U) D. <u>Schedule Profile:</u> Not Applicable.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
3 - Advanced Technology Development		0603789F C3 Advanced Development								4216	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4216 Warfighter Information Usage, Management, and Integration Technologies		2,180	1,343	2,393	2,503	2,691	2,742	2,813	Continuing	Continuing	

(U) A. **Mission Description and Budget Item Justification:** This project will develop and demonstrate the advanced technologies required to implement an interoperable, worldwide Information For The Warrior (IFTW) construct capable of supporting near-real-time multimedia (i.e., voice, data, video, and imagery) information exchange between ground and airborne platforms. The IFTW technology will provide "reachback" (i.e., updating information and mission changes to enroute aircraft and "in-transit visibility" of the aircraft and cargo status at Command and Control centers) to controlling headquarters. The IFTW capabilities will be enhanced through the incremental development, demonstration, and integration of advanced information management, airborne and ground communications, network and bandwidth management, communications protocols, and communications transmission systems technologies. It will address interoperability across echelon, Service, and multi-national force boundaries, as well as provide support for mobile command and control, and sensor-to-shooter operations. This program directly responds to user deficiencies as expressed by the Joint Staff (Command, Control, Communications, Computers, and Intelligence for the Warrior), the Air Force (Theater Deployable Communications), Air Mobility Command (Air Mobility Master Plan and Airborne Situational Awareness), and the Defense Information Systems Agency (Far-Term Defense Information Systems Network).

Project 4216

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Exhibit R-2 (PE 0603789F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT 4216	
3 - Advanced Technology Development	0603789F C3 Advanced Development		
(U) FY 1997 (\$ in Thousands):			
- (U) \$898	Designed, developed, and integrated advanced information management technologies.		
	- (U) Demonstrated integrated access to multiple operational command data bases and information structures.		
	- (U) Demonstrated intelligent retrieval of information from operational command data structures.		
- (U) \$500	Developed and integrated capabilities for presentation of a coherent picture of the retrieved data to the user.		
	Designed, developed, demonstrated, and integrated advanced airborne and super-high frequency communications technologies.		
	- (U) Performed a low data rate global communications ground test.		
	- (U) Completed the enhanced ultra high frequency and super-high frequency in-flight demonstration of commercial technologies.		
- (U) \$782	Performed an improved data processing assessment using the selected global broadcast service equipment suite.		
	Designed, developed, demonstrated, and integrated advanced network and bandwidth management and communications protocol technologies.		
	- (U) Demonstrated a distributed network management system with asynchronous transfer mode functionality.		
	- (U) Developed proxy agents and demonstrated interoperability.		
	- (U) Developed and demonstrated mission-based management.		
	- (U) Developed and demonstrated a mobility management module.		
- (U) \$2,180	Completed a protocols laboratory demonstration.		
	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$643	Design, develop, demonstrate, and integrate advanced information management technologies.		
	- (U) Demonstrate an integrated capability for data retrieval, transfer, and presentation to the user.		
- (U) \$383	Integrate Information For The Warrior (IFTW) demonstration with information management technologies.		
	Design, develop, demonstrate, and integrate advanced airborne and super-high frequency communications technologies.		
	- (U) Develop and demonstrate the improved higher data rate data processing demonstration -- global broadcast service integration brassboard.		
	- (U) Complete the improved higher data rate data processing demonstration -- global broadcast service in-flight demonstration.		
- (U) \$317	Integrate advanced communications technologies into the IFTW Advanced Technology Demonstration.		
	Design, develop, demonstrate, and integrate advanced network and bandwidth management and communications protocol technologies.		
	- (U) Develop and demonstrate the network planning module.		
	- (U) Integrate network and bandwidth management technologies into the IFTW Advanced Technology Demonstration.		

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Exhibit R-2 (PE 0603789F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>3 - Advanced Technology Development</b>	<b>0603789F C3 Advanced Development</b>		<b>4216</b>
<p>– (U) Conduct initial integration studies of incorporating new asynchronous transfer mode technology and emerging wireless asynchronous transfer mode techniques into the Information For The Warrior (IFTW) operational command environment.</p> <p style="text-align: right;">Total</p> <p>– (U) \$1,343</p>			
(U) FY 1999 (\$ in Thousands):			
– (U) \$ 740	Design, develop, demonstrate, and integrate advanced information management technologies.		
	– (U) Assess preliminary concept for development and integration of mediation (i.e., process of selecting the best communication routes) technologies and techniques.		
	– (U) Conduct initial evaluation of IFTW information management technologies in joint task force and international interoperability environments.		
– (U) \$ 825	Design, develop, demonstrate, and integrate advanced airborne and super-high frequency communications technologies.		
	– (U) Conduct ground demonstration of "low-cost" solution for airframe Ku/Ka band electronically steered phased array antenna.		
	– (U) Conduct preliminary investigation of future super-high frequency communications systems ability to provide additional in-transit visibility and reachback capabilities.		
– (U) \$ 828	Design, develop, demonstrate, and integrate advanced network and bandwidth management and communications protocol technologies.		
	– (U) Demonstrate advanced asynchronous transfer mode technology in an IFTW operational environment.		
	– (U) Conduct preliminary development of smart agents for transparently routing communications throughout the network.		
	– (U) Conduct preliminary application assessment of IFTW network and bandwidth management and protocol technologies in joint task force and international interoperability environments.		
– (U) \$2,393	Total		

Project 4216

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Exhibit R-2 (PE 0603789F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 3 - Advanced Technology Development

0603789F C3 Advanced Development

4216

(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	2,191	1,420	2,441	Cost
(U) Current Budget Submit/FY 1999 PB	2,180	1,343	2,393	Cont
				Cont

## (U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program and reflect the consolidation of PE 0603238F into this PE as Project 4216.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.(U) Related Activities:

- (U) PE 0602702F, Command, Control, and Communications (C3).
- (U) PE 0603726F, C3 Subsystem Integration.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 4216

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Exhibit R-2 (PE 0603789F)

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PE NUMBER: 0208019F

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PE TITLE: Tactical Information Program

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PROJECT	
4 - Demonstration and Validation										4778	
PE NUMBER AND TITLE										0208019F Tactical Information Program	
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4778	Integrated Broadcast Service	0	0	0	10,685	12,787	14,874	4,742	3,084	TBD	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	TBD	TBD

(U) The IBS program element (PE0603858F) was established after the FY 1999 President's Budget database locked. FY 1999 and out funds will be transferred to the new PE.

(U) **A. Mission Description and Budget Item Justification**

IBS will consolidate existing intelligence broadcast systems into a single interoperable, common-format, common-terminal, theater-tailored intelligence and information dissemination architecture. IBS will design, prototype, and field a new dissemination architecture, incorporating new functionality in broadcast and information management, a new message format, and a new receiver. This program is in budget activity 4 because it includes demonstrating and validating the use of technologies to create an operational integrated broadcast service.

(U) **Acquisition Strategy**

IBS will use a spiral development program to create a common dissemination architecture. Systems and technology will be contracted for under a competitive Request for Proposal (RFP) process.

- (U) FY 1999 (\$ in Thousands):
- (U) \$ 374 Program Management
  - (U) \$1,496 System Engineering
  - (U) \$2,876 Information Management Element
  - (U) \$1,396 Tactical Information Element/Enhanced Tactical Information Element
  - (U) \$2,707 Producer Information Element/Query
  - (U) \$ 115 Test
  - (U) \$1,721 Rapid Prototyping
  - (U) \$10,685 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

PE NUMBER AND TITLE

## 4 - Demonstration and Validation

0208019F Tactical Information Program

## PROJECT

4778

**(U) B. Program Change Summary (\$ in Thousands)**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>
(U) Previous President's Budget (FY 1998 PB)	0	0	0	
(U) Appropriated Value				
(U) Adjustments to Appropriated Value	0	0	0	
a. Cong Reductions				
b. SBIR				
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY 1998 PB				TBD
(U) Current Budget Submit/FY 1999 President's Budget				TBD
			+10,685	
			+10,685	

**(U) Change Summary Explanation:**

FY 1999 new start.

(U) C. Other Program Funding Summary (\$ in Thousands)

[illegible]

(U) Note: The IBS Program Management Office will publish an acquisition master plan, including schedule, by 1 Mar 98 per the DoD IPDM direction.

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Exhibit R-2 (PE 0208019F)

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0208019F Tactical Information Program

4778

### (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Program Management	0	0	\$ 489
(U) System Engineering	0	0	\$3,217
(U) Hardware/Software	0	0	\$6,979
(U) Total	0	0	\$10,685

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

**Performing Organizations:** (TBD - Estimate release of initial contract by 1 Sep 1998)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>					0	0	0	\$9,074*	TBD	TBD
TBD										
<u>Support and Management Organizations</u>					0	0	0	\$1,496*	TBD	TBD
TBD										
<u>Test and Evaluation Organizations</u>					0	0	0	\$ 115*	TBD	TBD
TBD										

\* Estimated disbursement of FY 1999 funds.

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Exhibit R-3 (PE 0208019F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

4 - Demonstration and Validation

0208019F Tactical Information Program

PROJECT

4778

(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

## Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Property</u>									
TBD				0	0	0	TBD	TBD	TBD
<u>Support and Management Property</u>									
TBD				0	0	0	TBD	TBD	TBD
<u>Test and Evaluation Property</u>									
TBD				0	0	0	TBD	TBD	TBD
Subtotal Product Development				0	0	0	\$9,074	TBD	TBD
Subtotal Support and Management				0	0	0	\$1,496	TBD	TBD
Subtotal Test and Evaluation				0	0	0	\$ 115	TBD	TBD
Total Project				0	0	0	\$10,685	TBD	TBD

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Exhibit R-3 (PE 0208019F)

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PE NUMBER: 0603260F

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PE TITLE: Intelligence Advanced Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
4 - Demonstration and Validation		0603260F Intelligence Advanced Development									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		4,478	4,489	4,615	4,615	4,525	4,584	4,684	Continuing	TBD	
3479 Advanced Sensor Exploitation		812	806	821	817	801	840	841	Continuing	TBD	
3480 Automated Imagery Exploitation		1,311	1,302	1,327	1,320	1,292	1,351	1,352	Continuing	TBD	
3481 Knowledge Based Tech For Intelligence		1,229	1,265	1,346	1,348	1,323	1,382	1,394	Continuing	TBD	
3482 Science & Tech Intelligence Methodology		1,126	1,116	1,121	1,130	1,109	1,011	1,097	Continuing	TBD	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

(U) Intelligence Advanced Development (IAD) demonstrates and validates advanced technology intelligence information systems required to support Global Awareness warfighter needs for timely all source intelligence information. IAD research supports consistent battlespace knowledge, precision information, and the execution of time critical missions. IAD projects provide better real-time information to the warfighter using new and existing data sources, streamline data analysis, reduce footprint required, extend life of sensors in place and enhance performance. Air Force Research Lab Rome Research Site (AFRL/IFE) works directly with users, employing a rapid prototyping evolutionary approach, integrating finished modules directly into the field. The programs are oriented toward specific shortfalls and deficiencies as documented by the major commands (MAJCOMS), unified commands, and intelligence organizations in their mission and function area plans. The goal of this program is to expedite technology transition from the laboratory to operational use via rapid prototyping and simulation. This is the only AF program focused on technology insertion to correct AF intelligence deficiencies at tactical or operation levels. The program is in Demonstration and Validation, Budget Activity 4, because it demonstrates and validates advanced technology which enhances intelligence systems capabilities and techniques.

**(U) Acquisition Strategy:**

All major contracts within this Program Element were awarded after full and open competition.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 4 - Demonstration and Validation

## 0603260F Intelligence Advanced Development

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY98)	4,686	4,738	4,709	TBD
(U) Appropriated Value	4,878	4,738		
(U) Adjustments to Appropriated Value				
a. Cong Reductions	(101)	(158)		
b. Small Business Innovative Research	(91)	(93)		
c. Omnibus and other Above Threshold Reprogrammings				
d. BTR				
e. Rescissions	(208)			
(U) Adjustments to Budget Year Since 1998 PB			(94)	
(U) Current Budget Submit/FY1999 President's Budget	4,478	4,489	4,615	TBD

## (U) Change Summary Explanation:

Funding: FY97: Actual reductions consist of general Congressional reductions and SBIR. BTR: Releases from AF to support CSEL requirement.

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands)

(U) Not Applicable

(U) RELATED ACTIVITIES:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation  
 63789F C3 Advanced Technology Development: correlation, fusion, signal processing  
 63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting  
 64750F Intelligence Equipment: modeling and simulation

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

## (U) D. Schedule Profile

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Consistent Operational Picture Initiated				X								
(U) Enhanced Analytical Tools Initiated			X									
(U) Imagery Exploitation 2000 Application Completed				X								
(U) Virtual Data Access Initiated	X											
(U) Video Digital Exploitation Completed				X								
(U) Airborne Range Imagery Algorithm Completed				X								
(U) Secure Image Ciphering using Chaos Theory Initiated/Completed	X			X								
(U) Mass Storage System Completed				X								
(U) Vision Pointer Completed				X								
(U) Multimedia for Information Access Initiated				X								
(U) Intelligence Application Browser Interface Initiated				X								
(U) Predictive Fusion Algorithms Initiate					X							
(U) Virtual Data Access Complete								X				
(U) Speech Technology for Image Exploitation Initiate					X							
(U) Information Integration Technology Initiate					X							
(U) Techniques for Secure Image Information Processing Initiate					X							
(U) Distributed Imagery Information System Integration Initiate					X							
(U) Multi-Processor for Automated Image Exploitation Complete												X
(U) Speech Technology for Image Exploitation Complete												

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

## February 1998

## BUDGET ACTIVITY

## 4 - Demonstration and Validation

## PE NUMBER AND TITLE

0603260F Intelligence Advanced Development

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
<hr/>			

1	2	3	4	1	2	3	4
<u>        </u>				<u>        </u>			
1	2	3	4	1	2	3	4
<u>        </u>				<u>        </u>			
1	2	3	4	1	2	3	4
<u>        </u>				<u>        </u>			

(U) Multi Spectral / Hyper Spectral Image  
Exploitation Application Initiate

## Exploitation Application Initiate

## (U) Intelligence Analysts Productivity

## Complete

## (U) Multisource Intelligence Notification

## Systems Prototype Initiated

X

X

X

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE		February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE						PROJECT			
4 - Demonstration and Validation		0603260F Intelligence Advanced Development						3479			
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3479	Advanced Sensor Exploitation	812	806	821	817	801	840	841	Continuing	TBD	

(U) A. Mission Description and Budget Item Justification

(U) There is an Air Force and Army need to correlate various sources of intelligence reports (Communications Intelligence - COMINT, Electronic Intelligence - ELINT, Image Intelligence - IMINT) within seconds as opposed to hours with current manual methods. Project includes development of data correlation and predictive intelligence algorithms, target analysis and prioritization, air order of battle updates and tactical analysis techniques. This computerized approach will speed up the correlation of data from diverse sources of intelligence information, including COMINT, ELINT, and IMINT; providing faster situational awareness and threat assessment and replace manual systems with automated capabilities.

(U) Acquisition Strategy:

All major contracts within this Program Element were awarded after full and open competition.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
4 - Demonstration and Validation	0603260F Intelligence Advanced Development	February 1998	3479
<p>(U) FY 1997 (\$ in Thousands):</p> <p>-(U) \$ 400 Initiated Consistent Operational Picture Via Distributed Fusion for Global Awareness.</p> <p>-(U) \$ 412 Initiated Enhanced Analytical Tools to Support Dynamic Situation Awareness.</p> <p>-(U) \$ 812 Total (Discrete efforts: Three bullet criteria—N/A )</p>			
<p>(U) FY 1998 (\$ in Thousands):</p> <p>-(U) \$ 400 Continue Consistent Operational Picture Via Distributed Fusion for Global Awareness.</p> <p>-(U) \$ 200 Continue Enhanced Analytical Tools to Support Dynamic Situation Awareness.</p> <p>-(U) \$ 206 Initiate Predictive Fusion Algorithms to Support Dynamic Planning</p> <p>-(U) \$ 806 Total</p>			
<p>(U) FY 1999 (\$ in Thousands):</p> <p>-(U) \$ 400 Continue Consistent Operational Picture Via Distributed Fusion for Global Awareness.</p> <p>-(U) \$ 200 Continue Enhanced Analytical Tools to Support Dynamic Situation Awareness.</p> <p>-(U) \$ 221 Continue Predictive Fusion Algorithms to Support Dynamic Planning.</p> <p>-(U) \$ 821 Total</p>			

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

## BUDGET ACTIVITY

## 4 - Demonstration and Validation

PE NUMBER AND TITLE

0603260F Intelligence Advanced Development

## PROJECT

**3479**

(U) B. Program Change Summary (\$ in Thousands)

Total	Cost	TBD
-------	------	-----

<u>FY 1997</u>	812	846
----------------	-----	-----

<u>FY 1998</u>	851	851
----------------	-----	-----

	FY 1999
	838

(U) Previous President's Budget (FY98)

(U) Appropriated Value

U) Adjustments to Appropriated Value

### a. Cong Reductions

### **b. Small Business Innovative Research**

### c. Omnibus and other Above Threshold

## Reprogrammings

d. BTR

### e. Rescissions

(U) Adjustments to Budget Year Since 1998 PB

(U) Current Budget Submit/FY1999 President's Budget

(U) Change Summary Explanation:

Funding: N/A

**Schedule:** N/A

**Technical:** N/A

(U) C. Other Program Funding Summary (\$ in Thousands)

(U) Not Applicable

(U) RELATED ACTIVITIES:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, information handling, sensor exploitation

63789F C3 Advanced Technology Development: correlation, fusion, signal processing

**63726F C3 Subsystem Integration: advanced image/information, advanced optical memory technology**

### 64750F Intelligence Equipment: modeling and simulation

Project 3479

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

### BUDGET ACTIVITY

## 4 - Demonstration and Validation

PE NUMBER AND TITLE

0603260F Intelligence Advanced Development

## PROJECT

**3479**

**(U) D. Schedule Profile**

FY 1997

2

1

(U) Enhanced Analytical Tools Awarded

(U) Consistent Operational Picture

**Awarded**

(U) Predictive Fusion Algorithms Award

FY 1998

2

Figure 1

4

X

X

EY 1999

2

**Figure 1**

4

7

EY 1999

2

**Figure 1**

4

7

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603260F Intelligence Advanced Development	3479	
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>			
		<u>FY 1997</u>	<u>FY 1998</u>
			<u>FY 1999</u>
(U) Consistent Operational Picture		400	400
(U) Enhanced Analytical Tools		412	200
(U) Predictive Fusion Algorithms		0	221
(U) Total		812	806
			821

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3479

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<b>Product Development Organizations</b>										
Electric Computing Concepts	CPFF	Jan 97	N/A	N/A	N/A	412	200	200	Cont.	TBD
BTG, Inc 97-C-0341	CPFF	Aug 97	N/A	N/A	N/A	400	400	400	Cont.	TBD
Contractor TBD	TBD	TBD	TBD	TBD	0	0	206	221	Cont.	TBD

Support and Management Organizations - N/A

Test and Evaluation Organizations - N/A

### Government Furnished Property: N/A

Subtotal Product Development	812	806	821	TBD
Subtotal Support and Management	0	0	0	0
Subtotal Test and Evaluation	0	0	0	0
Total Project	812	806	821	TBD

Project 3479

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

## 0603260F Intelligence Advanced Development

3480

COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3480 Automated Imagery Exploitation	1,311	1,302	1,327	1,320	1,292	1,351	1,352	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

(U) This project demonstrates and validates the capability to more accurately and quickly interpret digital imagery by evaluating computer assisted techniques to manipulate and overlay imagery, cartographic data, signal intelligence (SIGINT), and on line intelligence data. The result of this effort will be more precise target locations and identifications, precise target reference scenes, and more accurate damage assessments; all developed for easy supportability on low cost commercially available computer workstations. This project will also develop data links which can be used to provide digital imagery to theater and tactical units.

(U) Acquisition Strategy:

All major contracts within this Program Element were awarded after full and open competition.

(U) FY 1997 (\$ in Thousands):

--(U) \$ 448 Completed Image Exploitation 2000 Application in Support of Global Awareness and Dynamic Planning  
 -- (U) \$ 145 Initiated Virtual Data Access for Global Awareness and Dynamic Planning.  
 -- (U) \$ 100 Completed Video Digital Image Exploitation for Freeze Frame Analysis.  
 -- (U) \$ 375 Continued Multi-processor for Automated Image Exploitation.  
 -- (U) \$ 134 Completed Airborne Range Imagery Algorithms to Derive Three Dimensional Geographic Locations.  
 -- (U) \$ 109 Initiated/Completed Secure Image Cipherng using Chaos Theory  
 -- (U) \$1,311 Total

Project 3480

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

0603260F Intelligence Advanced Development PROJECT  
3480

## 4 - Demonstration and Validation

## (U) FY 1998 (\$ in Thousands):

- (U) \$ 400 Complete Virtual Data Access for Global Awareness and Dynamic Planning.  
 - (U) \$ 300 Continue Multi-Processor for Automated Image Exploitation  
 - (U) \$ 228 Initiate Speech Technology for Image Exploitation.  
 - (U) \$ 179 Initiate Information Integration Technology.  
 - (U) \$ 100 Initiate Techniques for Secure Image Information Processing.  
 - (U) \$ 95 Initiate Distributed Imagery Information Systems Integration.  
 - (U) \$1,302 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$ 400 Complete Multi-processor for Automated Image Exploitation.  
 - (U) \$ 300 Continue Distributed Imagery Information Systems Integration.  
 - (U) \$ 300 Continue Techniques for Secure Image Information Processing.  
 - (U) \$ 160 Continue Information Integration Technology.  
 - (U) \$ 100 Complete Speech Technology for Image Exploitation.  
 - (U) \$ 67 Initiate Multi Spectral / Hyper Spectral Image Exploitation Applications.  
 - (U) \$1,327 Total

Project 3480

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3480

(U) B. Program Change Summary (\$ in Thousands)

				Total
				Cost
				TBD

(U) Previous President's Budget (FY98)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

a. Cong Reductions

b. Small Business Innovative Research

c. Omnibus and other Above Threshold

Reprogramming

d. BTR

e. Rescissions

(U) Adjustments to Budget Year since 1998 PB

(U) Current Budget Submit/FY1999 President's Budget

(U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands)

(U) Not Applicable

(U) RELATED ACTIVITIES:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, information handling, sensor exploitation  
 63789F C3 Advanced Technology Development: correlation, fusion, signal processing  
 63726F C3 Subsystem Integration: advanced image/information applications, advanced optical memory technology  
 64750F Intelligence Equipment: modeling and simulation

Project 3480

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE		February 1998		PROJECT	
BUDGET ACTIVITY				PE NUMBER AND TITLE		0603260F Intelligence Advanced Development		3480	
(U) D. Schedule Profile									

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3480

## (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Imagery Exploitation 2000	448		
(U) Virtual Data Access	145	400	
(U) Video Digital Image Exploitation	100		
(U) Multi Processor for Auto Image Exploit	375	300	400
(U) Airborne Range Imagery Algorithms	134		
(U) Secure Image Ciphering	109		
(U) Speech Technology for Image Exploitation		228	100
(U) Information Integration Technology		179	160
(U) Secure Image Information Processing		100	300
(U) Distributed Imagery Information System Integration		95	300
(U) Multi Spectral / Hyper Spectral Image Applications			67
(U) Total	1,311	1,302	1,327

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

0603260F Intelligence Advanced Development

PROJECT

3480

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Lockheed 95-C-0127	CPFF	Jan 95	N/A	N/A	33	100	0	0	Cont.	TBD
TASC 96-C-0036	CPFF	Feb 96	N/A	N/A	90	134	0	0	Cont.	TBD
Nichols 96-C-0083	CPFF	May 96	N/A	N/A	0	375	418	50	Cont.	TBD
MTL Systems Inc 96-C-0068	CPFF	Mar 96	N/A	N/A	0	145	0	0	Cont.	TBD
PAR Govt Sys Corp 97-C-0093	CPFF	May 96	N/A	N/A	0	448	556	652	Cont.	TBD
State University of NY at Binghamton 97-C-0105	CPFF	Jun 96	N/A	N/A	0	109	328	625	Cont.	TBD

Support and Management Organizations - N/ATest and Evaluation Organizations - N/A

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3480

(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

## Government Furnished Property: N/A

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY			Budget to Complete	Total Program
						1997	1998	1999		
Subtotal Product Development					123	1,311	1,302	1,327	TBD	0
Subtotal Support and Management					0	0	0	0	0	0
Subtotal Test and Evaluation					0	0	0	0	0	0
Total Project					123	1,311	1,302	1,327	TBD	TBD

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

## 0603260F Intelligence Advanced Development

3481

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3481 Knowledge Based Tech For Intelligence	1,229	1,265	1,346	1,348	1,323	1,382	1,394	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

(U) This project will reduce manpower and warning times for respective Strategic Command (STRATCOM), Air Combat Command (ACC), Air Force Space Command (AFSPC), Air Intelligence Agency (AIA), and 497th Intelligence Group data handling systems. The development of the analytical aids is based on artificial intelligence techniques. The increased timeliness, efficiency and effectiveness derived will provide warning time and accuracy, allowing national/military authorities a greater range of options to avert, diminish or control a crisis.

(U) Acquisition Strategy:

All major contracts within this Program Element were awarded after full and open competition.

(U) FY 1997 (\$ in Thousands):

- (U) \$ 299 Continued Enhancing Intelligence Analysts Productivity at AIA.
- (U) \$ 430 Continued Machine Learning Prototype, expert system and neural network technologies to support real-time analysis of timeliness.
- (U) \$ 137 Completed Enhanced Mass Storage System to satisfy the growing need to store and retrieve large digital files representing imagery, charts, maps, text, etc.
- (U) \$ 101 Completed the Vision Pointer application which analyzes collected signals and characterizes signals to differentiate between specific platforms.
- (U) \$ 200 Initiated Multimedia for information Access for analysts at AIA and users of Image Product Archive (IPA).
- (U) \$ 62 Initiated Intelligence Application Browser Interfaces for analysts at ACC and AIA.
- (U) \$1,229 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603260F Intelligence Advanced Development	3481	
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 360	Continue Enhancing Intelligence Analysts Productivity at AIA.		
- (U) \$ 390	Continue Machine Learning Prototype, expert system and neural network technologies to support real-time analysis of timeliness.		
- (U) \$ 380	Continue Multimedia for information Access for analysts at AIA and users of Image Product Archive (IPA).		
- (U) \$ 135	Continue Intelligence Application Browser Interfaces for analysts at ACC and AIA.		
- (U) \$1,265	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$ 300	Complete Enhancing Intelligence Analysts Productivity at AIA.		
- (U) \$ 330	Continue Machine Learning Prototype, expert system and neural network technologies to support real-time analysis of timeliness.		
- (U) \$ 363	Continue Multimedia for information Access for analysts at AIA and users of Image Product Archive (IPA).		
- (U) \$ 353	Continue Intelligence Application Browser Interfaces for analysts at ACC and AIA.		
- (U) \$1,346	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3481

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous President's Budget (FY98)	1,437	1,335	1,373	
(U) Appropriated Value	1,496	1,335		
(U) Adjustments to Appropriated Value				
a. Cong Reductions	(31)	(44)		
b. Small Business Innovative Research	(28)	(26)		
c. Omnibus and other Above Threshold Reprogramming				
d. BTR				
e. Rescissions	(208)			
(U) Adjustments to Budget Year since 1998 PB			(27)	
(U) Current Budget Submit/FY1999 President's Budget	1,229	1,265	1,346	TBD

## (U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

## (U) C. Other Program Funding Summary (\$ in Thousands)

(U) Not Applicable

## (U) RELATED ACTIVITIES:

62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation  
 63789F C3 Advanced Technology Development: correlation, fusion, signal processing  
 63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting  
 64750F Intelligence Equipment: modeling and simulation

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603260F Intelligence Advanced Development								3481	
(U) D. <u>Schedule Profile</u>		FY 1997		FY 1998		FY 1999					
		1	2	3	4	1	2	3	4		
(U) Enhanced Mass Storage System Completed					4						
(U) Vision Pointer Completed					X						
(U) Multimedia Information Access Initiated					X						
(U) Intelligence Application Browser Interfaces Initiated					X						
(U) Intel Analysts Productivity Completed											X

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE			
4 - Demonstration and Validation	0603260F Intelligence Advanced Development			3481
(U) A. Project Cost Breakdown (\$ in Thousands)				
		FY 1997	FY 1998	FY 1999
(U) Intelligence Analysts Productivity		299	360	300
(U) Machine Learning Prototype		430	390	330
(U) Enhanced Mass Storage System		137		
(U) Vision Pointer		101		
(U) Multimedia for Information Access		200	380	363
(U) Intelligence Applications Browser Interfaces		62	135	353
(U) Total		1,229	1,265	1,346

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT
BUDGET ACTIVITY			PE NUMBER AND TITLE									
4 - Demonstration and Validation			0603260F Intelligence Advanced Development								3481	
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)												
Performing Organizations:												
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program		
Product Development Organizations												
Synectics Corp 94-C-0127	CPFF	Aug 94	N/A	N/A	575	137	0	0	Cont.	TBD		
Harris Corp 94-D-0055	CPFF	Feb 96	N/A	N/A	292	101	0	0	Cont.	TBD		
GTE 96-C-0085	CPFF	May 96	N/A	N/A	0	430	390	330	Cont.	TBD		
Booz Allen 96-C-0092	CPFF	Jun 96	N/A	N/A	58	299	360	300	Cont.	TBD		
Kaman Science Corp 97-C-0053	CPFF	May 96	N/A	N/A	0	200	380	363	Cont.	TBD		
Synectics Corp 97-C-0073	CPFF	Jul 96	N/A	N/A	0	62	135	353	Cont.	TBD		
Support and Management Organizations - N/A												
Test and Evaluation Organizations - N/A												

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)									
BUDGET ACTIVITY									
4 - Demonstration and Validation									
Government Furnished Property: N/A									
Contractor or Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete
									Total Program
Subtotal Product Development					925	1,229	1,265	1,346	TBD
Subtotal Support and Management					0	0	0	0	0
Subtotal Test and Evaluation					0	0	0	0	0
Total Project					925	1,229	1,265	1,346	TBD

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603260F Intelligence Advanced Development								3482	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3482	Science & Tech Intelligence Methodology	1,126	1,116	1,121	1,130	1,109	1,011	1,097	Continuing	TBD	
<p>(U) A. <u>Mission Description and Budget Item Justification</u></p> <p>(U) Demonstrates and validates intelligence methodologies and techniques for operational employment of simulation models in support of Air Intelligence Agency (AIA) requirements. The methods and techniques will help AIA improve their analysis of current and future foreign weapon systems, and prevent technological surprises with regard to the capabilities of these systems. The program is Demonstration and Validation, Budget Activity 4.</p> <p>(U) <u>Acquisition Strategy:</u> All major contracts within this Program Element were awarded after full and open competition.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u>            - (U) \$ 500 Continued Applied Deception Techniques for Manipulative Deception of Foreign Signal Collection Systems.            - (U) \$ 626 Continued Intelligence Analyst Associate (Build 2) for Automated Information Extraction from Text using Natural Language Understanding.            - (U) \$1,126 Total</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u>            - (U) \$ 400 Continue Applied Deception Techniques for Manipulative Deception of Foreign Signal Collection Systems            - (U) \$ 400 Continue Intelligence Analyst Associate (Build 2) for Automated Information Extraction            - (U) \$ 316 Continue Multisource Intelligence Notification Systems (MINS) Prototype.            - (U) \$ 1,116 Total</p> <p>(U) <u>FY 1999 (\$ in Thousands):</u>            - (U) \$ 400 Complete Applied Deception Techniques for Manipulative Deception of Foreign Signal Collection Systems            - (U) \$ 400 Continue Intelligence Analyst Associate (Build 2) for Automated Information Extraction            - (U) \$ 321 Continue Multisource Intelligence Notification Systems (MINS) Prototype.            - (U) \$ 1,121 Total</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>4 - Demonstration and Validation</b>	<b>0603260F Intelligence Advanced Development</b>	<b>3482</b>	
<b>(U) B. Program Change Summary (\$ in Thousands)</b>			
(U) Previous President's Budget (FY98)	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	1,126	1,178	1,144
(U) Adjustments to Appropriated Value	1,171	1,178	
a. Cong Reductions	(24)	(39)	
b. Small Business Innovative Research	(21)	(23)	
c. Omnibus and other Above Threshold Reprogramming			
d. BTR			
e. Rescissions			
(U) Adjustments to Budget Year since 1998 PB			(23)
(U) Current Budget Submit/FY1999 President's Budget	1,126	1,116	1,121
			TBD
<b>(U) Change Summary Explanation:</b>			
Funding:	N/A		
Schedule:	N/A		
Technical	N/A		
<b>(U) C. Other Program Funding Summary (\$ in Thousands)</b>			
(U) Not Applicable			
<b>(U) RELATED ACTIVITIES:</b>			
62720F C3I Exploratory Development: optical storage, speech processing, signals exploitation, data handling, sensor exploitation			
63789F C3 Advanced Technology Development: correlation, fusion, signal processing			
63726F C3 Subsystem Integration: mass storage, hypermedia database, voice translation, mapping and charting			
64750F Intelligence Equipment: modeling and simulation			
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
4 - Demonstration and Validation		3482	
(U) D. Schedule Profile		0603260F Intelligence Advanced Development	
		PE NUMBER AND TITLE	
		FY 1997	FY 1998
		1 2 3 4	1 2 3 4
(U) Multisource Intelligence Notification			
System (MINS) Prototype Initiated			
(U) Applied Deception Techniques			
Completed			
(U) Intel Analyst Associate (Build 2)			
Completed			

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603260F Intelligence Advanced Development

3482

### (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Applied Deception Techniques	500	400	400
(U) Intelligence Analysts Associate (Build 2)	626	400	400
(U) Multisource Intelligence Notofocation System (MINS) Prototype		316	321
(U) Total	1,126	1,116	1,121

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Calspan 96-C-0108	CPFF	Sep 96	N/A	N/A	87	626	400	400	Cont.	TBD
E-Systems 96-C-0194	CPFF	Sep 96	N/A	N/A	19	500	400	400	Cont.	TBD
Contractor TBD	TBD	TBD			0	0	316	321	Cont.	TBD

Support and Management Organizations - N/A
Test and Evaluation Organizations - N/A

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE		0603260F Intelligence Advanced Development		3482
Government Furnished Property: N/A						
Subtotal Product Development		106	1,126	1,116	1,121	TBD
Subtotal Support and Management		0	0	0	0	0
Subtotal Test and Evaluation		0	0	0	0	0
Total Project		106	1,126	1,116	1,121	TBD

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PE NUMBER: 0603319F

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PE TITLE: Airborne Laser Program

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603319F Airborne Laser Program								4269	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4269 Airborne Laser		56,037	151,439	292,219	314,242	150,739	175,954	152,580	0*	1,336,718*	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

\* The FY98 President's Budget (PB) R-2 submission included the cost of both Airborne Laser (ABL) Program Definition and Risk Reduction (PDRR) and Engineering and Manufacturing Development (EMD) in this PE 0603319F line. Since then, the AF has created PE 0604350F (BPAC 654687) for ABL EMD costs, moved the FY 2003 EMD costs to the new PE, and realigned EMD funding beyond the FYDP to PE 0604350F. The Total Cost now reflects cost for Concept Design and PDRR only and contains \$43,508 in funds prior to FY 1997.

\*\*This Qty is for the acquisition of commercial 747-400F freighter aircraft. These aircraft are incrementally funded beginning in the years identified.

**(U) A. Mission Description and Budget Item Justification:**

The Airborne Laser (ABL) Program is an ACAT ID program which will design, build and test a laser weapon system to acquire, track and kill Theater Ballistic Missiles (TBMs) in the boost phase. This weapon system integrates three major subsystems (Laser, Beam Control and Battle Management Command, Control, Communications, Computers and Intelligence (BMC4I)) into a modified commercial Boeing 747-400F aircraft. The program awarded the ABL PDRR contract to the Boeing/TRW/Lockheed-Martin team in November 1996, to design, fabricate, integrate, and test the half-power ABL system. The PDRR phase culminates with a lethality (missile shoot-down) demonstration against a boosting TBM representative target in FY 2002. The PDRR phase will integrate and test all key technologies needed for a fully operational system, allowing the Air Force to advance into EMD in FY 2003. This program is in budget activity 4 - Demonstration and Validation since it is a major defense acquisition program which has been authorized to enter PDRR as of the Milestone I, November 1996.

**(U) Acquisition Strategy:**

Milestone (MS) I decision was November 1996 authorizing entry into PDRR; MS II for EMD in FY 2003; MS III Decision for Production in FY 2005. The PDRR program is structured to demonstrate technical risk reduction achievements at key junctures throughout the PDRR phase. The Air Force Service Acquisition Executive will review the program at two key points (Authority-to-Proceed I & II) during PDRR to ensure planned progress is attained. PDRR culminates with a lethality (missile shoot-down) demonstration against a boosting theater ballistic missile in FY 2002.

Project 4269

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603319F Airborne Laser Program

4269

## (U) FY 1997 (\$ in Thousands):

- (U) \$ 9,731 Completed both Concept Design contracts

- (U) \$31,898 Initiated Boeing/TRW/Lockheed-Martin PDRR contract effort for design, fabrication, integration, and test the ABL weapon system

- (U) \$ 255 Completed Environmental Impact Analysis contract

- (U) \$ 4,829 Support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft, and aircraft integration

- (U) \$ 9,324 Support for atmospheric characterization tests, labor, training, Integrated Product Team (IPT) participation, and other government agencies

- (U) \$56,037 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$137,456 Continue Boeing/TRW/Lockheed-Martin PDRR contract effort for design, fabrication, integration, and test the ABL weapon system

- (U) \$ 700 Minor modification to Birk facility at Edwards AFB, CA by Boeing/TRW/Lockheed-Martin. Project number FSPM981305. Project title: Airborne Laser Complex Upgrade

- (U) \$ 4,090 Support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft, and aircraft integration

- (U) \$ 9,143 Support for atmospheric characterization tests, labor, training, Integrated Product Team (IPT) participation, and other government agencies

- (U) \$ 50 Government support to contractor modification to Birk facility at Edwards AFB, CA. Project number FSPM981305.

- (U) \$151,439 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$281,733 Continue Boeing/TRW/Lockheed-Martin PDRR contract effort for design, fabrication, integration, and test the ABL weapon system

- (U) \$ 1,825 Minor modification to Birk facility at Edwards AFB, CA by Boeing/TRW/Lockheed-Martin. Project number FSPM981305. Project title: Airborne Laser Complex Upgrade

- (U) \$ 3,970 Support for special studies, simulations and analyses, technical support, risk management, and an independent review team specializing in lasers, aircraft, and aircraft integration

- (U) \$ 4,516 Support for labor, training, Integrated Product Team (IPT) participation, and other government agencies

- (U) \$ 175 Government support to contractor modification to Birk facility at Edwards AFB, CA. Project number FSPM981305.

- (U) \$292,219 Total

Project 4269

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
4 - Demonstration and Validation	0603319F Airborne Laser Program		4269	
(U) B. <u>Program Change Summary (\$ in Thousands)</u>				
(U) Previous President's Budget FY 1998 PB	FY 1997	FY 1998	FY 1999	Total
(U) Appropriated Value	54,227	157,136	296,596	Cost
(U) Adjustments to Appropriated Value	56,828	157,136		2,524,994
a. Congressional/General Reductions	-1,210	-5,697		
b. SBIR	-1,391			
c. Omnibus or Other Above Threshold Reprogram	1,900			
d. Below Threshold Reprogramming	-90			
e. Recissions			-4,377	
(U) Adjustments to Budget Years Since FY 1998 PB		151,439	292,219	1,336,718
(U) Current Budget Submit/FY 1999 PB	56,037			
(U) Change Summary Explanation:				
Funding: Added \$1,900 in FY 1997 to support atmospheric characterization data collection efforts and adjunct mission studies. FY 1999 funding reduced by \$4,377 due to downward revision in inflation estimates and other DoD adjustments. Beginning in FY 2003, \$1,118,300 has been realigned to the EMD PE 0604350F.				
Schedule: Funding reductions in FY 1998 slip the completion of initial adjunct mission studies 1 year.				
Technical: FY 1998 adjustments caused curtailment of participation in Roving Sands 98 and Tactical Weather Decision Aids effort. FY 1999 - FY 2003 funding reductions cause cancellation of all target lethality, enemy countermeasures efforts, and atmospheric data collection and analysis, thereby increasing overall ABL program risk.				

Project 4269

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603319F Airborne Laser Program								4269	
(U) C. Other Program Funding Summary (\$ in Thousands)											
(U) RELATED ACTIVITIES:											
		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost	
(U) PE 0604350F Airborne Laser EMD		0	0	0	0	0	0	242,843	866,300	1,109,143	
(U) PE 0603605F Advance Weapons Technology Project 3647 - High Energy Laser Technologies*										Continuing	
* This effort is developing technologies for potential performance enhancements above current requirements identified in the ABL Operational Requirements Document (ORD).											
(U) D. Schedule Profile											
		FY 1997			FY 1998			FY 1999			
		1	2	3	4	1	2	3	4		
(U) Award PDRR Contract	X										
(U) Completed Concept Design		X									
(U) Program Requirements Review		X									
(U) Order PDRR "Green" Aircraft											
(U) Flight-weighted Laser Module Demo											
(U) Preliminary Design Review											
(U) Authority to Proceed (ATP) - 1											
(U) Laser Module Airworthiness Demo											
(U) Laser Module Scaling Demo											
(U) Critical Design Review											
(U) Lethality Demonstration (FY 2002)											
(U) Milestone II (FY 2003)											
(U) Milestone III (FY 2005)											

Project 4269

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603319F Airborne Laser Program

4269

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Major Contracts (PDRR contract and Concept Design)	41,629	138,156	283,558
(U) Support Contracts (Technical Support, Analysis)	5,084	4,090	3,970
(U) Test/Other Government/Misc Support/Salaries/IPTs	9,324	9,193	4,691
(U) Total	56,037	151,439	292,219

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Boeing Defense & Space Group Seattle, WA *	CPAF	12 Nov 96	1,153,605	1,214,478	0	31,898	138,156	283,558	760,866	1,214,478
Concept Design Contract (Rockwell International, CA)	CPFF	9 May 94	21,395	21,395	16,780	4,615	0	0	0	21,395
Concept Design Contract (Boeing Defense & Space Group, WA)	CPFF	9 May 94	21,689	21,689	16,573	5,116	0	0	0	21,689

Project 4269

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603319F Airborne Laser Program

4269

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
<u>Support and Management Organizations</u>										
Technical Support Contracts	Various	Varies	N/A	N/A	5,800	5,084	4,090	3,970	4,340	23,284
Government In-House and Other External Support	Various	Varies	N/A	N/A	4,355	9,180	8,593	1,491	5,753	29,372
<u>Test and Evaluation Organizations</u>										
Air Force Flight Test Center (AFFTC) **	MIPR	Varies	N/A	N/A	0	144	600	3,200	22,556	26,500

Government Furnished Property: None

## NOTES:

\* Project Office EAC was approved at the time of contract award and has been updated to reflect contract changes to date. Project Office EAC includes funds budgeted for risk mitigation identified during Source Selection. Since the FY 1998 PB, the Performing Activity's EAC has been adjusted upward to account for two risk mitigation efforts -- additional Software Lines of Code (SLOC) and Advanced Adaptive Optics (AAO).

\*\* AFFTC is the single face to the customer for Test and Evaluation. AFFTC receives funding from the Program Office and controls the distribution of these funds within AFFTC, the White Sands Missile Range (WSMR) and the Western Test Range (WTR).

Project 4269

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)					DATE	PROJECT			
BUDGET ACTIVITY									
4 - Demonstration and Validation					PE NUMBER AND TITLE	PROJECT			
					0603319F Airborne Laser Program	4269			
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u>									
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Subtotal Product Development				33,353	41,629	138,156	283,558	760,866	1,257,562
Subtotal Support and Management				10,155	14,264	12,683	5,461	10,093	52,656
Subtotal Test and Evaluation				0	144	600	3,200	22,556	26,500
Total Project				43,508	56,037	151,439	292,219	793,515	1,336,718

Project 4269

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PE NUMBER: 0603430F

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PE TITLE: Advanced MILSATCOM (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603430F Advanced MILSATCOM (Space)								4050	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4050 Advanced MILSATCOM		32,403	38,307	54,413	52,326	234,315	481,569	497,821	2,582,960	4,024,943	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**

Develop and acquire Advanced Extremely High Frequency (EHF) Military Satellite Communications (MILSATCOM) satellites with necessary modifications to the mission control segment for survivable, jam-resistant, worldwide, secure communications for the strategic and tactical warfighter. Advanced EHF satellites will replenish the existing EHF (Milstar) system. It will use many components from standard commercial buses and will launch on a medium launch vehicle. The Advanced EHF capability will be available for first launch not later than 2006. Activities funded under this program element implement the Secretary of Defense's 1993 MILSATCOM Bottom Up Review decision to field a lower cost, advanced MILSATCOM satellite. The Advanced EHF program implements the architecture defined by the DoD Space Architect and directed by the Joint Space Management Board. This program is in Budget Activity 4, Research Category Demonstration and Validation, since it funds technology validation and fabrication of an Advanced EHF satellite system.

**Acquisition Strategy:** The Advanced MILSATCOM strategy is a competitive acquisition between two contractors. One contractor will be selected to perform engineering and manufacturing development and fabrication of five satellites. Advanced MILSATCOM will incorporate improvements from Milstar and commercial SATCOM practices into the next generation EHF military communication satellite system.

(U) FY 1997

- (U)\$ 14,303 Continued Advanced EHF technology validation.
- (U)\$ 15,100 Initiated processing Subsystem Engineering Model Program.
- (U)\$ 1,000 Continued Advanced Technology Program basic Program Office support activities.
- (U)\$ 2,000 Funded Joint Terminal Engineering Office (JTEO).
- (U)\$ 32,403 Total

Project 4050

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation		0603430F Advanced MILSATCOM (Space)	4050	
(U) FY 1998				
-	(U)\$ 2,145	Continue Advanced EHF technology validation.		
-	(U)\$ 36,000	Continue processing Subsystem Engineering Model Program.		
-	(U)\$ 162	Continue Advanced Technology Program basic Program Office support activities.		
-	(U)\$ 38,307	Total		
(U) FY 1999				
-	(U)\$ 1,761	Continue Advanced EHF technology validation.		
-	(U)\$ 52,486	Continue processing Subsystem Engineering Model Program.		
-	(U)\$ 166	Continue Advanced Technology Program basic Program Office support activities.		
-	(U)\$ 54,413	Total		
(U) B. Program Change Summary (\$ in Thousands)				
(U)	Previous President's Budget (FY 1998 PB)		FY 1997	FY 1998
(U)	Appropriated Value		30,453	41,448
(U)	Adjustments to Appropriated Value		31,643	41,000
	a. Congressional General Reductions		-846	-2,693
	b. SBIR		-344	
	c. Omnibus and Other Above Threshold Reprogram			
	d. Below Threshold Reprogram		2,000	
	e. Rescissions		-50	
(U)	Adjustments to Budget Years Since FY 1998 PB			
(U)	Current Budget Submit/FY 1999 President's Budget		32,403	38,307
				-5,094
				54,413
				4,024,943
(U) Change Summary Explanation:				
Funding: \$2M FY97 Below Threshold Reprogramming action funded Joint Terminal Engineering Office (JTEO) activities. FY99 Engineering Model and technology validation funding reduced to accommodate higher priority AF requirements.				
Schedule: None.				
Technical: None.				

Project 4050

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603430F Advanced MILSATCOM (Space)

4050

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Complete	To	Total Cost
(U) Not Applicable.										

## (U) Related RDT&amp;E:

(U) PE 0604479F, Milstar LDR/MDR Satellite Communications

(U) PE 0604577N, EHF Satellite Communications

(U) PE 0603432F, Polar Satellite Communications Program (Polar Adjunct)

## (U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999	
	1	2	3	4	1	2	3	4
(U) Technology Project Awards/Renewals		x				x		
(U) Start Processing Subsystem Engineering Model								
(U) System Definition 1QFY00								
(U) Milestone II - Mid FY00								
(U) EHF program EMD Start - Mid FY01								
(U) First Delivery - FY06								

Project 4050

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE		February 1998			
BUDGET ACTIVITY										PE NUMBER AND TITLE		PROJECT			
4 - Demonstration and Validation										0603430F Advanced MILSATCOM (Space)		4050			
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>										FY 1997		FY 1998		FY 1999	
(U) MILSATCOM Technology Validation Program										14,303		2,145		1,761	
(U) Processing Subsystem Engineering Model										15,100		36,000		52,486	
(U) Architecture & Requirements Definition										0		0		0	
(U) Other Government Costs										3,000		162		166	
(U) Total										32,403		38,307		54,413	
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>															
<u>Performing Organizations:</u>															
<u>Contractor or Government Performing Activity</u>	<u>Contract Method/Type or Funding Vehicle</u>	<u>Award or Obligation Date</u>	<u>Performing Activity EAC</u>	<u>Project Office EAC</u>	<u>Total Prior to FY 1997</u>	<u>Budget FY 1997</u>	<u>Budget FY 1998</u>	<u>Budget FY 1999</u>	<u>Budget to Complete</u>	<u>Total Program</u>					
<u>Product Development Organizations</u>															
MIT/LL	MIPR	Feb 95	6,258	6,258	4,300	2,000	1,500	1,761	922	10,483					
Lockheed	CPFF	Jan 95	7,604	7,604	5,336	2,268	0	0	0	7,604					
Hughes	CPFF	Jan 95	2,486	2,486	2,486	0	0	0	0	2,486					
TRW	CPFF	Jan 95	4,850	4,850	3,408	1,442	0	0	0	4,850					
TRW	CPFF	Feb 95	1,071	1,071	1,071	0	0	0	0	1,071					
HSC/Loral	CPFF	Jan 95	4,777	4,777	3,196	1,581	0	0	0	4,777					
Boeing	CPFF	Jan 95	3,648	3,648	2,779	869	0	0	0	3,648					
TRW	CPFF	Feb 95	2,998	2,998	2,572	426	0	0	0	2,998					
Texas Instruments	CPFF	Jan 95	3,215	3,215	2,452	763	0	0	0	3,215					
MIT/LL	MIPR	Feb 95	3,800	3,800	2,400	1,200	0	0	0	3,600					
Various Tech Proj	Various	Jan 95	29,886	29,886	14,690	3,754	645	0	0	19,089					
Arch Requirements	Various	Jan 96	4,809	4,809	4,809	0	0	0	0	4,809					
Hughes	CPFF	May 97	15,100	15,100	0	8,100	19,200	26,718	15,254	69,272					
TRW	CPFF	May 97	2,000	2,000	0	7,000	16,800	25,768	13,346	62,914					
JTEO	CPFF	Jul 97	TBD	TBD	0	2,000	0	0	79,017	81,017					
TBD	TBD	TBD	TBD	TBD	0	0	0	0	3,427,757	3,427,757					
Project 4050														Exhibit R-3 (PE 0603430F)	
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)						DATE	February 1998	PROJECT		
BUDGET ACTIVITY		PE NUMBER AND TITLE					4050			
4 - Demonstration and Validation		0603430F Advanced MILSATCOM (Space)								
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations										
Various	Various	2Q95	N/A	N/A	1,330	1,000	162	166	312,695	315,353
<u>Test and Evaluation Organizations</u>										
TBD										
<u>Government Furnished Property:</u>										
None										
Subtotal Product Development										
Subtotal Support and Management										
Subtotal Test and Evaluation										
Total Project										
					49,499	31,403	38,145	54,247	3,536,296	3,709,590
					1,330	1,000	162	166	312,695	315,353
					0	0	0	0	TBD	TBD
					50,829	32,403	38,307	54,413	3,848,991	4,024,943

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PROJECT	
PE NUMBER AND TITLE										4052	
4 - Demonstration and Validation										0603432F Polar Adjunct (Space)	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4052 Polar Satellite Communications		59,439	14,511	41,508	40,429	26,771	13,325	8,863	TBD	TBD	
Quantity of RDT&E Articles		1	0	0	0	0	0	1	0	0	

**(U) A. Mission Description and Budget Item Justification**

The Program will provide protected communications services to U.S. forces operating in the northern polar region. In 1992, the Milstar program was restructured, and the requirement for Milstar to provide polar coverage was deleted. The Air Force was directed to find a more cost-effective solution to polar requirements. In Oct 94, the DoD identified an immediate need for protected polar communications, and in Jul 95, the Joint Requirements Oversight Council (JROC) validated the Polar MILSATCOM ORD which contained the interim requirements. In July 95, the Defense Acquisition Executive reviewed the Polar program and approved execution of an interim program to place a modified Extremely High Frequency (EHF) payload from the Navy's UHF Follow On (UFO) system onto a host satellite to provide limited requirements satisfaction while pursuing a long term solution. In Aug 96, the Joint Space Management Board (JSMB) addressed that long term solution by approving proposals from the DoD Space Architect to "sustain EHF Polar capability through about 2010 (24 hours)". In Nov 97, the first package was launched on a classified host satellite. This program provides for design, integration and launch of two more packages by the classified host program office.

The Polar Satellite Communications Program is in Budget Activity 4, Demonstration and Validation, based on a 30 Mar 95 USD(A&T) memorandum to pursue the interim hosted solution (Interim Polar).

Acquisition Strategy: Hosted package on classified satellites. Classified program office does not provide funding in greater detail than what is presented below.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$20,831 Complete design, satellite modification, and payload integration and test for the interim payload. (Through the classified host contract)
- (U) \$38,608 Continue integration and test activities for Polar package 1 and initiate planning for Polar package 2. (Through the classified host contract)
- (U) \$59,439 Total

**(U) FY 1998 (\$ in Thousands):**

- (U) \$14,511 Continue Polar package planning and design for the next generation payload, initiate parts procurement for Polar packages 2 and 3, and develop payload. (Through the classified host contract)
- (U) \$14,511 Total

**(U) FY 1999 (\$ in Thousands):**

- (U) \$41,508 Continue payload development and integration development with host vehicle for Polar packages 2 and 3. (Through the classified host contract)
- (U) \$41,508 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4052

## 4 - Demonstration and Validation

## 0603432F Polar Adjunct (Space)

Total  
TBD

## (U) B. Program Change Summary (\$ in Thousands)

FY 1997

FY 1998

FY 1999

(U) Previous President's Budget (FY 1998 PB)

59,537

29,585

30,643

(U) Appropriated Value

62,387

15,000

(U) Adjustments to Appropriated Value

-1,306

-489

(U) a. Congressional General Reductions

-1,544

(U) b. SBIR

(U) c. Omnibus/Other Above Threshold Reprogramming

(U) d. Below Threshold Reprogramming

-98

(U) e. Rescissions

(U) Adjustments to Budget Years Since FY98 PB

+10,865

(U) Current Budget Submit/FY 1999 President's Budget

14,511

41,508

TBD

(U) Change summary explanation:

Funding: FY99 adjusted to add funding for two additional polar packages (Polar numbers 2 and 3).

Schedule: None.

Technical: None

## (U) C. Other Program Funding Summary (\$ in Thousands)

PE 0302109N Navy SATCOM Ship Terminals.

## (U) D. Schedule Profile

FY 1997

FY 1998

FY 1999

1

2

3

4

1

2

3

4

1

2

3

4

Launch Hosted Interim Payload (Polar Package 1)

Polar package 2 launch FY03

Polar package 3 launch FY04

Project 4052

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)									
BUDGET ACTIVITY		PE NUMBER AND TITLE		DATE		PROJECT			
4 - Demonstration and Validation		0603432F Polar Adjunct (Space)				February 1998			
						4052			
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>									
		FY 1997	FY 1998	FY 1999					
(U) Package 1 Fabrication		20,831							
(U) Package 1 Integration/Test		38,608							
(U) Packages 2 & 3 Integration Development and Parts Buy			14,511	41,508					
(U) Total		59,439	14,511	41,508					
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>									
<u>Performing Organizations:</u>									
Contractor or									
Government	Method/Type	Award or	Performing	Project	Total				
Performing	or Funding	Obligation	Activity	Office	Prior to				
Activity	Vehicle	Date	EAC	EAC	FY 1997	Budget	Budget	Budget to	Total
					FY 1997	FY 1998	FY 1999	Complete	Program
<u>Product Development Organizations</u>									
Classified	Classified	June 95	Continuing	Continuing	73,457	59,439	41,508	TBD	TBD
<u>Support and Management Organizations</u>									
Support and Management Organizations None									
<u>Test and Evaluation Organizations</u>									
Test and Evaluation Organizations None									
<u>Government Furnished Property:</u>									
Product Development Property - None									
Support and Management Property - None									
Test and Evaluation Property - None									
Subtotal Product Development					73,457	59,439	41,508	TBD	TBD
Subtotal Support and Management					0	0	0		
Subtotal Test and Evaluation					0	0	0		
Total Project					73,457	59,439	41,508	TBD	TBD

Project 4052

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PE NUMBER: 0603434F

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PE TITLE: National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)								4056	
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
COST (\$ In Thousands)											
4056	National Polar-orbiting Operational Env. Sat. Syst.	27,622	31,438	64,732	95,646	132,260	214,861	257,319	TBD	TBD	
	Quantity of RDT&E Articles	0	0	0	0	1*	0	0	1	2	
<p>* Initiatives first RDT&amp;E spacecraft bus build.</p> <p>(U) A. <u>Mission Description and Budget Item Justification</u>            The National Performance Review (NPR) and subsequent Presidential Decision Directive/NSTC-2 (May 1994) direct the Departments of Defense (DoD) and Commerce (DOC) and the National Aeronautics and Space Administration to establish a converged national weather satellite program. The converged program, the National Polar-orbiting Operational Environmental Satellite System (NPOESS), will combine the follow-on to DoD's Defense Meteorological Satellite Program (DMSP) and the DOC's Polar-orbiting Operational Environmental Satellite (POES) program. An integrated tri-agency program office was established on 1 Oct 94 to manage the acquisition and operations of the converged satellite. NPOESS will provide operational military commanders and civilian leaders timely, quality weather information to effectively employ weapon systems and protect national resources. The converged program will be the nation's single source of global weather data for operational DoD and DOC use. It will provide visible and infrared cloud cover imagery and other meteorological, oceanographic, and solar-geophysical information. At least three satellites (two U.S. and one European) will be required in sun synchronous 450 nm polar orbit at all times (sun synchronous means the satellites cross the equator at the same local sun time on each of their 14 orbits/day). On 17 March 1997, NPOESS successfully completed Milestone I. DOC and Air Force budget adjustments, in the fall of 1997, reduced NPOESS funding below the Milestone I approved program. The program was subsequently rebaselined and approved by the Executive Committee (EXCOM). DoD and DOC equally funded the rebaselined NPOESS program to maintain a 50/50 cost share ratio by year. This PE is in Budget Activity 4 (Demonstration and Validation) because it currently supports sensor and satellite bus development.</p> <p>(U) <u>Acquisition Strategy</u>            The guiding tenets for NPOESS acquisition include accomplishing substantial risk reduction with a focus on payload development, accelerating user satisfaction, deferring major system decisions as long as reasonable, and protecting maximum flexibility to ensure the best overall system design. The program pursues a significant investment in the development and on-orbit testing of selected payload sensors while deferring individual sensor selections among competing international, NASA, military, and industry alternatives to assess and determine the optimum technical performance potential of each candidate sensor. Overall system prime contractor selection is being deferred to minimize system level preliminary costs, allow sensor complement maturation, and delay the commitment to full system acquisition until approximately seven years before the first satellite need date.</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)	4056	
(U) FY 1997 (\$ in Thousands)			
-	(U) \$ 4,510	Continued system architecture studies.	
-	(U) \$ 6,037	Continued Program Definition and Risk Reduction efforts.	
-	(U) \$ 8,045	Continued Milestone I Review, began critical sensor and algorithm development with multiple contractors.	
-	(U) \$ 9,030	Continued Government-led risk reduction and technology development efforts.	
-	(U) \$ 27,622	Total	
(U) FY 1998 (\$ in Thousands)			
-	(U) \$ 976	Continue to support Program Definition and Risk Reduction efforts.	
-	(U) \$ 3,000	Continue system architecture studies.	
-	(U) \$ 3,850	Continue Government-led risk reduction and technology development efforts.	
-	(U) \$ 23,612	Continue critical sensor/algorithm development efforts.	
-	(U) \$ 31,438	Total	
(U) FY 1999 (\$ in Thousands)			
-	(U) \$ 2,500	Continue to support Program Definition and Risk Reduction efforts.	
-	(U) \$ 4,600	Complete system architecture studies and initiate system definition contracts.	
-	(U) \$ 6,800	Continue Government-led risk reduction and technology development efforts.	
-	(U) \$ 50,832	Continue critical sensor development.	
-	(U) \$ 64,732	Total	

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Exhibit R-2 (PE 0603434F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

4056

0603434F National Polar-orbiting Operational  
Environmental Satellite System (NPOESS) (Space)(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY1998)	27,688	51,504	113,234	TBD
(U) Appropriated Value	29,000	34,004		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-607	-1,929		
b. SBIR	-725	-637		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions	-46			
(U) Adjustments to Budget Years Since FY1998 PB			-48,502	
(U) Current Budget Submit/FY1999 President's Budget	27,622	31,438	64,732	TBD
(U) Change Summary Explanation:				

**Funding:** FY1999 adjustment - program rebaselined (EXCOM approved) to accommodate OMB/DOC concerns regarding sensor development schedule.**Schedule:** Delayed system development and first satellite delivery by 6 months from Jan 07 to Jul 07.**Technical:** Restructured the DMSP and POES modification projects for on-orbit testing of new NPOESS sensors.(U) C. Other Program Funding Summary (\$ in Thousands)

Not Applicable.

Related RDT&E:

(U) PE #305160F, DMSP

(U) PE #305160N, DMSP (provides funds for the development of Navy unique sensors)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998		
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT			
4 - Demonstration and Validation	0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)	4056			
(U) D. <u>Schedule Profile</u>					
		FY 1997	FY 1998	FY 1999	
		1 2 3	1 2 3	2 3 4	
(U) Milestone 1 Review		X			
(U) Request for Proposal for sensor development		X			
(U) Sensor and Algorithm Development Contract Awards (6 Separate Contracts)					
(U) Program Rebaselined					
(U) Selected Sensor Downselects					
(U) Complete System Architecture Studies					
(U) Award NPOESS System Definition Contracts					

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

BUDGET ACTIVITY	PE NUMBER AND TITLE	DATE	PROJECT
4 - Demonstration and Validation	0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)	February 1998	4056

## (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) System Architecture Studies/Definition & C3	4,510	3,000	4,600
(U) Government Led Risk Reduction/ Technology efforts	9,030	3,850	6,800
(U) Program Definition and Risk Reduction (sensor development) contracts/ Program Support	14,082	24,588	53,332
(U) Total	27,622	31,438	64,732

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
System Arch./Defin. & C3	C/CPFF	Sep 96	TBD*	TBD*	5,310	4,510	3,000	4,600	TBD*	TBD*
Lockheed	C/CPAF	2QFY95	Comp	Comp	4,489	0	0	0	0	4,489
Hughes Aircraft Co	CPFF	Jul 97	TBD	TBD	0	1,402	7,005	9,275	TBD*	TBD*
Ball Aerospace	CPFF	Jul 97	TBD	TBD	0	1,402	2,096	5,375	TBD*	TBD*
ITT Aerospace	CPFF	Jul 97	TBD	TBD	0	1,402	7,005	9,275	TBD*	TBD*
Hughes Space and Communications	CPFF	Jul 97	TBD	TBD	0	701	1,373	4,525	TBD*	TBD*
Orbital Sciences	CPFF	Jul 97	2,275	2,275	0	702	723	850	0	2,275
SAAB Erickson	FFP	Jul 97	2,086	2,086	0	701	1,685	0	0	2,086

\* The IPO is currently restructuring the existing contracts to meet the new funding levels.

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Exhibit R-3 (PE 0603434F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE										4056
4 - Demonstration and Validation		0603434F National Polar-orbiting Operational Environmental Satellite System (NPOESS) (Space)										
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete TBD	Total Program TBD		
Other PDRR & Follow-on efforts	MISC	Various	TBD	TBD	0	1,735	3,725	21,532	TBD	TBD		
Gov't Led Studies	Gov. Orgs.	MISC.	TBD*	TBD*	8,550	9,030	3,850	6,800	TBD*	TBD*		
Support and Management Organizations												
Integrated Program Office (IPO) Support	Various	Various	N/A	N/A	6,396	6,037	976	2,500	TBD**	TBD**		
Test and Evaluation Organizations												
TBD**									TBD**	TBD**		
Government Furnished Property:												
Not Applicable.												
Subtotal Product Development*												
Subtotal Support and Management												
Subtotal Test and Evaluation												
Project Total												
* Includes all program phases												
** The IPO is currently restructuring the existing contracts to meet the rebaselined program funding levels.												

Project 4056

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Exhibit R-3 (PE 0603434F)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE		February 1998						
BUDGET ACTIVITY										PE NUMBER AND TITLE								
4 - Demonstration and Validation										0603441F Space Based IR Arch (Dem/Val) (Space)								
COST (In Thousands)										FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost										252,492	202,433	160,262	154,133	115,398	0	0	0	1,432,558
0007 SBIRS Low										241,493	199,677	160,262	154,133	115,398	0	0	0	1,397,992
0008 Cobra Brass										10,999	2,756	0	0	0	0	0	0	34,566
Quantity of RDT&E Articles										0	0	0	3	0	0	0	0	3

Note: SBIRS Low EMD activities are funded in PE #060442F starting in FY01.

**(U) A. Mission Description and Budget Item Justification**

(U) The Space-Based Infrared System's (SBIRS) primary mission is to provide initial warning of a ballistic missile attack on the US, its deployed forces or its allies. SBIRS will incorporate new technologies to enhance detection; improve reporting of Intercontinental Ballistic Missiles (ICBM), Submarine Launched Ballistic Missiles (SLBM) and tactical ballistic missiles; and provide critical mid-course tracking and discrimination data for national and theater missile defense. This system will provide increased performance in order to meet requirements in US Space Command's Capstone Requirement Document and Operational Requirements Document. SBIRS will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated centralized ground station serving all SBIRS space elements and the Defense Support System (DSP) satellites. PE #30591F funds DSP, PE#60442 funds SBIRS Low Engineering and Manufacturing Development (EMD) at deployment and PE #604441F funds SBIRS High EMD activities.

(U) This PE funds the SBIRS Low Program Definition and Risk Reduction (PDRR) activities and Cobra Brass (CB). SBIRS Low is the LEO component of SBIRS. CB will provide data primarily for the Defense Intelligence Agency (DIA)/Central MASINT (Measurement and Signature Intelligence) Office (CMO), and secondarily for the GEO and HEO components. This program is funded in Budget Activity 4, Demonstration and Validation, because it funds risk reduction and an advanced technology demonstration system.

**(U) Acquisition Strategy:**

(U) The SBIRS program is managed through a single consolidated System Program Office (SPO) at the Space and Missile Systems Center, Los Angeles Air Force Base, CA. The SBIRS Low Flight Demonstration System (FDS) acquisition plan was approved in Aug 92. The FDS contract was awarded to TRW in May 95, and two FDS satellites are scheduled to launch 1QFY00. To maintain competition for the EMD phase of the program, a second Competitive Dem/Val contract was awarded (3 Sep 96) to Boeing/Lockheed-Martin for work on an alternative design concept, Low Altitude Demonstration System (LADS), and to demonstrate that concept on orbit in FY99-FY00.

(U) CB is currently being developed by Sandia National Laboratory, Albuquerque, NM, to explore the utility of staring, fastframing, multi-spectral electro-optical sensors for Theater Missile Defense (TMD), Technical Intelligence (TI), and Battlespace Characterization (BSC) missions. CB will fly on a classified host satellite.



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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE  
February 1998

## BUDGET ACTIVITY

## PE NUMBER AND TITLE

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

## (U) B. Program Change Summary (\$ in Thousands)

(U) Previous President's Budget (FY 1998 PB)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

a. Cong Gen Reductions

b. SBIR

c. Omnibus or Other Above Threshold Reprogram

d. Below Threshold Reprogramming

e. Rescission

(U) Adjustments to Budget Years Since FY 1998 PB

(U) Current Budget Submit/FY 1999 President's Budget

FY 1997	FY 1998	FY 1999	Total Cost
237,532	222,401	126,485	1,323,103
249,151	217,401		
-5,793	-9,511		
-5,826	-5,457		
19,045*			
-3,700			
-385			
252,492	202,433	33,777	1,432,558
		160,262	

## (U) Change Summary Explanation:

Funding: \$12,055K FY97 Omnibus reprogramming action processed but not yet reflected in funding database. Funds will be used for FDS cost growth. FY97 BTR to PE 64441F for Miniature Sensor Technology Integration (MSTI) requirements.

\$1.41M FY98 additional inflation and SBIR reductions not yet reflected in funding database. \$20M FY98 Above Threshold Reprogramming request is to be submitted to Congress in early March 1998. Funds are required to maintain a SBIRS Low first launch in 2004.

FY99 increase funds FDS and LADS cost growths and on-orbit testing to validate SBIRS Low Capabilities.

Schedule: FDS and LADS launches changed from 3QFY99 to 1QFY00.

Technical: Environmental sensors on FDS and LADS eliminated

## (U) C. Other Program Funding Summary (\$ in Thousands)

Not applicable

## Related RDT&amp;E:

(U) PE #60441F - SBIRS High EMD

(U) PE #305911F - DSP

(U) PE #60442F - SBIRS Low EMD

FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
193,018	316,467	538,438	564,239	395,905	269,798	143,059	102,566	2,801,661
24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

(U) D. Schedule Profile

	<u>FY 1997</u>			<u>FY 1998</u>			<u>FY 1999</u>		
	1	2	3	4	1	2	3	4	
(U) SBIRS Low FDS Critical Design Review (CDR)	X								
(U) SBIRS Low FDS Launch (1QFY00)									
(U) SBIRS Low LADS PDR Initial Systems Design Integration				X					
(U) SBIRS Low LADS CDR Final Systems Design Integration									X
(U) SBIRS Low LADS Launch (1QFY00)									
(U) Cobra Brass Launch (classified)									

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

PROJECT

0007

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0007	SBIRS Low	241,493	199,677	160,262	154,133	115,398	0	0	0	1,397,992
	Quantity of RDT&E Articles	0	0	0	3	0	0	0	0	3

\*\$12,055K FY97 Omnibus reprogramming action processed but not yet reflected in funding database. Funds will be used for FDS cost growth.

(U) A. Mission Description and Budget Item Justification

(U) SBIRS Low represents the Low Earth Orbit (LEO) component of the Space Based InfraRed System (SBIRS). The objective SBIRS LEO constellation of Low-earth orbiting satellites will provide global, below- and above-the-horizon access to strategic and tactical ballistic missiles in boost, post-boost, and midcourse phases of flight, and also track missile targets during reentry. LEO will support the four SBIRS mission areas: Missile Warning, Missile Defense, Technical Intelligence, and Battle Space Characterization.

(U) Acquisition Strategy:

(U) While SBIRS Low and Cobra Brass are part of the overall SBIRS, there are on-going contracts for each of these efforts. The GEO component of SBIRS is a pilot program for acquisition streamlining. The traditional Defense Acquisition Board (DAB) documentation for an ACAT ID program was consolidated into a Single Acquisition and Management Plan (SAMP) for the GEO component. The existing SBIRS Single Acquisition Management Plan (SAMP) will be updated to reflect the LEO component.

(U) The SBIRS Low Flight Demonstration System (FDS) acquisition plan was approved in Aug 92. The developing organization for the SBIRS Low FDS satellites is the Air Force Space and Missile Center, Los Angeles AFB, CA. On 2 May 95, the FDS flyer contract was awarded to TRW, Redondo Beach, CA, to design and build two FDS satellites to launch in 1Q FY00. Boeing North America, formerly Rockwell International Space Systems Division, Downey, CA, was awarded an FDS non-flyer contract. On 3 Sep 96, Boeing North America, Downey, CA, was awarded a competitive Dem/Val contract to develop the Low Altitude Demonstration System (LADS).

(U) The FDS Non-flyer contract with Boeing was terminated in Dec 1996 in favor of the competitive Dem/Val contract.

(U) Program Definition Risk Reduction (PDRR) activities will begin in early FY99 with up to two Program Definition Risk Reduction study contracts. The purpose of Program Definition Risk Reduction is to develop specifications and designs for the SBIRS LEO EMD phase. This period will also be used to optimize the SBIRS HEO, GEO, LEO constellations and to revalidate the Air Force Space Command Operational Requirements Document. Pre-EMD contractors will compete for an EMD contract to be awarded in FY01. The same streamlined acquisition approach currently used for the GEO EMD will be used as a baseline for the LEO EMD. First launch of the operational LEO constellation will occur in FY04.

(U) FY 1997 (\$ in Thousands)

- (U) \$ 133,193 Continue SBIRS Low FDS satellite and ground segment development.
- (U) \$ 86,900 Low Altitude Demonstration System
- (U) \$ 4,700 Technologies
- (U) \$ 13,200 Program office activities.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

## BUDGET ACTIVITY

## PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

0007

Total Cost

(U) Adjustments to Budget Years Since FY 1998 PB  
(U) Current Budget Submit/ FY 1999 President's Budget

FY 1997	FY 1998	FY 1999	Total Cost
241,493	199,677	33,777	1,397,992

## (U) Change Summary Explanation:

Funding: \*\$12,055K FY97 Omnibus reprogramming action processed but not yet reflected in funding database.

Funds will be used for FDS cost growth.FY97 \$3,700K to PE 64441F. \$4,214K transferred from BPAC 0007 to BPAC 0008 within this PE 63441F.

In FY98, \$1.410M is pending reprogramming to fund higher priority AF requirements. In FY98, a \$20M Above Threshold Reprogramming is pending congressional approval.

FY99 increase funds FDS and LADS cost growths and on-orbit testing to validate SBIRS-Low capabilities.

Schedule: FDS and LADS launches changed from 3QFY99 to 1QFY00

Technical: Environmental sensors on FDS and LADS eliminated.

(U) C. Other Program Funding Summary (\$ in Thousands)

Not Applicable

Related RDT&E:

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) PE #604441F - SBIRS High EMD	193,018	316,467	538,438	564,239	395,905	269,798	143,059	102,566	2,801,661
(U) PE #305911F - DSP	24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
(U) PE #604442F - SBIRS Low EMD	0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056

(U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) SBIRS Low FDS Critical Design Review (CDR)	1	2	3	4	1	2	3	4	2
(U) SBIR Low FDS Launch (1QFY00)	X								
(U) LADS Initial Systems Design Integration									
(U) LADS Final Systems Design Integration									
(U) LADS Launch (1QFY00)									

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

0007

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) FDS satellite and ground segment	133,193	102,036	80,400
(U) Low Altitude Demonstration System (LADS)	86,900	68,154	51,262
(U) Technologies	4,700	6,700	7,100
(U) Targets		5,900	6,600
(U) Program office activities	13,200	13,600	13,500
(U) Space-Based Visible (SBV)	1,400		
(U) Simulation, Discrimination and Computer Support	2,100	1,400	1,400
(U) Adjustments: (Pending Reprogramming)		1,887	
(U) Total	241,493	199,677	160,262

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or

Government

Performing

Activity

Method/Type

or Funding

Vehicle

Award or

Obligation

Date

Performing

Activity

EAC

Project

Office

EAC

Total

prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

#### Product Development Organizations

FDS - TRW*	CPAF	May 95	706,488*	341,863	133,193*	102,036	80,400	36,941	694,433*
LADS - Boeing	CPFF	Sep 96	234,127	15,000	86,900	68,154	51,262	12,811	234,127
Non-Flyer - RI	CPAF	May 95	130,643	130,643	0	0	0	0	130,643
Misc. Contracts	Various	Various	TBD	9,981	8,200	14,000	15,100	193,879	241,160

\*\$12,055K FY97 Omnibus reprogramming action processed but not yet reflected in funding database. Funds will be used for FDS cost growth.

#### Support and Management Organizations

Aerospace	Various	N/A	16,307	8,400	8,900	8,800	18,000	60,407
SETA/SPO	Various	N/A	13,235	4,800	4,700	4,700	7,900	35,335
Support								

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)					DATE	February 1998				
BUDGET ACTIVITY		PE NUMBER AND TITLE			PROJECT					
4 - Demonstration and Validation		0603441F Space Based IR Arch (Dem/Val) (Space)			0007					
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations					0	0	0	0	0	0
Not Applicable										
Government Furnished Property: Not Applicable.										
Subtotal Product Development					497,487	228,293	184,190	146,762	243,631	1,300,363
Subtotal Support and Management					29,542	13,200	13,600	13,500	25,900	95,742
Subtotal Test and Evaluation										
Adjustments: (Pending Reprogramming)							1,887			1,887
Total Project					527,029	241,493	199,677	160,262	269,531	1,397,992
Note: Where applicable, totals do not include funds previous to FY95 which all came from outside this PE										

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

0008

COST (In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0008	Cobra Brass	10,999	2,756		0	0	0	0	0	34,566
Quantity of RDT&E Articles		0	1*	0	0	0	0	0	0	0

\* RDT&amp;E articles not separately priced.

(U) A. Mission Description and Budget Item Justification

(U) The Cobra Brass (CB) Program was a DIA/CMO (Central MASINT Office) Research and Development program to explore the utility of staring, fast framing, multi-spectral electro-optical sensors. CB was combined with the SBIRS program as a result of the Feb 95 Defense Acquisition Executive review. This approach is a significant departure from the traditional approach of scanning, slow framing, single band sensors previously used for Tactical Warning and Attack Assessment (TW/AA).

(U) Previous CB sensors have demonstrated the ability of this technology to contribute to Theater Missile Defense (TMD), Technical Intelligence (TI), and Battlespace Characterization (BSC) missions. Major program emphasis is to increase the timeliness of sensor tasking and reporting. This will allow CB data to be processed in realtime through the existing theater infrastructure. CB will support the GEO and HEO component of the SBIRS.

(U) Acquisition Strategy

(U) The CB was transferred on 1 October 94 to the Air Force from DIA/CMO as part of risk mitigation for the baselined SBIRS program and was included into the SBIRS Low PDRR program element. Sandia National Laboratory (SNL) is the Air Force's executing agent for CB. The Air Force is responsible for funding CB through sensor and ground segment development and integration with the host satellite. Once on orbit, responsibility for funding, sensor operation, and data exploitation will be performed by other government agencies.

## (U) FY 1997 (\$ in Thousands):

- (U)	\$ 5,020	Payload
- (U)	\$ 1,636	Satellite Integration & Checkout
- (U)	\$ 4,343	Ground Station Build
- (U)	\$ 10,999	Total

## (U) FY 1998 (\$ in Thousands):

- (U)	\$ 1,856	Ground Station testing (Funds will be transferred from BPAC 640007 to BPAC 640008 within PE 63441F)
- (U)	\$ 900	Payload pre-flight testing and checkout integration onto spacecraft
- (U)	\$ 2,756	Total

Project 0008

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Exhibit R-2 (PE 0603441F)



## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>4 - Demonstration and Validation</b>	<b>0603441F Space Based IR Arch (Dem/Val) (Space)</b>	<b>0008</b>	
(U) FY 1999 (\$ in Thousands):			
- (U) \$0	Not applicable		
<b>(U) B. Program Change Summary (\$ in Thousands)</b>			
(U) Previous President's Budget/FY 1998 PB		FY 1997	FY 1998
(U) Appropriated Value		6,785	2,960
(U) Adjustments to Appropriated Value			2,960
a. Cong Gen Reductions			-96
b. SBIR			-108
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming		4,214	
(U) Adjustments to Budget Years Since FY98 PB			
(U) Current Budget Submit/FY 1999 President's Budget		10,999	2,756
			0
			34,566
<b>(U) Change Summary Explanation:</b>			
Funding FY97 \$300K Below Threshold Reprogramming from PE 0305911F, \$3.914 reallocation between projects to support increased CB requirements.			
Schedule: Not Applicable			
Technical: Not Applicable			
<b>(U) C. Other Program Funding Summary (\$ in Thousands): Not Applicable</b>			
<b>Related RDT&amp;E:</b>			
Not Applicable			
<b>(U) D. Schedule Profile</b>			
(U) Payload Consent to Ship Decision		FY 1997	FY 1998
(U) Grd Station Build 1 Testing Complete at Sandia	1	2 3	2 3 4
		X	
(U) Grd Station Build 1 Installed at Ground Site			
(U) CB Launch			
			X

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603441F Space Based IR Arch (Dem/Val) (Space)

0008

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Payload	5,020	0	0
(U) Ground Station Build	4,343	0	0
(U) Satellite Integration and Checkout	1,636	0	0
(U) Ground Station Testing	0	1,856	0
(U) MIPR to National Air Intelligence Center	0	900	0
(U) Total	10,999	2,756	0

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations										
Sandia Nat'l Labs	Various	Various			20,811	10,999	2,756	0	0	34,566
Support and Management Organizations										
Not Applicable										
Test and Evaluation Organizations										
Not Applicable										

#### Government Furnished Property: Not Applicable

Subtotal Product Development	20,811	10,999	2,756	0	0	34,566
Subtotal Support and Management						
Subtotal Test and Evaluation	20,811	10,999	2,756	0	0	34,566
Project Total						

Project 0008

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Exhibit R-3 (PE 0603441F)

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PE NUMBER: 0603617F

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PE TITLE: Command Control &amp; Communications Applications

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
PE NUMBER AND TITLE											
0603617F Command Control & Communications Applications											
Applications											
BUDGET ACTIVITY											
4 - Demonstration and Validation											
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
Total Program Element (PE) Cost	3,992	7,232	7,770	7,975	8,049	8,166	8,319	Continuing	TBD		
2314 Tactical Air Surveillance	1,014	762	448	458	461	465	472	Continuing	TBD		
2317 Tactical Air Information Production & Distribution	530	2,648	3,080	3,156	3,184	3,233	3,294	Continuing	TBD		
2321 Tactical Battle Information Management	2,198	3,693	4,037	4,136	4,175	4,228	4,307	Continuing	TBD		
3804 Tactical Air Forces Systems Integration	250	129	205	225	229	240	246	Continuing	TBD		
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

**(U) A. Mission Description and Budget Item Justification:**

This program is designed to rapidly transition development efforts in the science and technology base directly to warfighting commands. Projects are directly responsive to operational requirements for improved battle management, communications, theater missile defense (TMD), and surveillance capability. This program takes advantage of advanced technology developments throughout the services and industry as well as off-the-shelf technology. The program also defines system architectures and develops communications technology for modernization and improving the Air Force portion of the Tri-Service communications networks which the Defense Information Systems Agency (DISA) oversees. This program is in Category 4, Demonstration and Validation, because its products are primarily advanced development models, rapid prototype efforts, and software developed through evolutionary acquisition methods.

**(U) Acquisition Strategy:**

All major contracts within this Program were awarded after full open competition. (When restricted technologies are involved, foreign competition is not allowed.) Most contracts are of the cost plus fixed fee (CPFF) type, but when it is deemed appropriate by procurement officials, award fee contracts or firm-fixed price contracts are utilized.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																																																							
BUDGET ACTIVITY	PE NUMBER AND TITLE																																																								
<b>4 - Demonstration and Validation</b>	<b>0603617F Command Control &amp; Communications Applications</b>	<b>February 1998</b>																																																							
<p>(U) <b>B. <u>Program Change Summary (\$ in Thousands)</u></b></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>(U) Previous Presidents Budget (FY 1998 PB)</td> <td>4,179</td> <td>7,650</td> <td>7,926</td> <td>Cost</td> </tr> <tr> <td>(U) Appropriated Value</td> <td>4,378</td> <td>7,650</td> <td></td> <td>TBD</td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    a. Congressional Reductions</td> <td>-114</td> <td>-273</td> <td></td> <td></td> </tr> <tr> <td>    b. Small Business Innovative Research</td> <td>-85</td> <td>-145</td> <td></td> <td></td> </tr> <tr> <td>    c. Omnibus/Other Above Threshold Reprogramming</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    d. Below Threshold Reprogramming</td> <td>-180</td> <td></td> <td></td> <td></td> </tr> <tr> <td>    e. Rescissions</td> <td>-7</td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Budget Years Since FY 1998 PB</td> <td></td> <td></td> <td>-156</td> <td></td> </tr> <tr> <td>(U) Current Budget Submit/FY 1999 President's Budget</td> <td>3,992</td> <td>7,232</td> <td>7,770</td> <td>TBD</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:</p> <p>Funding: See individual projects.</p> <p>Schedule: N/A</p> <p>Technical: N/A</p> <p>(U) <b>C. <u>Other Program Funding Summary (\$ in Thousands)</u></b> - See individual projects.</p> <p>(U) <b>D. <u>Schedule Profile</u></b> - See individual projects.</p>				FY 1997	FY 1998	FY 1999	Total	(U) Previous Presidents Budget (FY 1998 PB)	4,179	7,650	7,926	Cost	(U) Appropriated Value	4,378	7,650		TBD	(U) Adjustments to Appropriated Value					a. Congressional Reductions	-114	-273			b. Small Business Innovative Research	-85	-145			c. Omnibus/Other Above Threshold Reprogramming					d. Below Threshold Reprogramming	-180				e. Rescissions	-7				(U) Adjustments to Budget Years Since FY 1998 PB			-156		(U) Current Budget Submit/FY 1999 President's Budget	3,992	7,232	7,770	TBD
	FY 1997	FY 1998	FY 1999	Total																																																					
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(U) Current Budget Submit/FY 1999 President's Budget	3,992	7,232	7,770	TBD																																																					

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2314

Applications

COST (\$ in Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2314	Tactical Air Surveillance	1,014	762	448	458	461	465	472	Continuing	TBD
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification** Develops advanced technology and demonstrates equipment improvements to the Theater Air Control System (TACS) ground surveillance radars. Investigates non-radar and/or adjunct radar sensors to address the Combat Air Forces (CAF) surveillance, detection, and tracking requirements not satisfied by an active radar. Develops advanced surveillance technology in support of next generation sensors and sensor signal processing.

## (U) FY 1997 (\$ in Thousands):

- (U) \$ 499 Completed tube based transmitter panel for AN/TPS-75.
- (U) \$ 515 Initiated waveform and signal processor design and evaluation.
- (U) \$1,014 **Total**

## (U) FY 1998 (\$ in Thousands):

- (U) \$ 90 Initiate Track Before Detect for Theater Missile Defense (TMD) with adaptive elevation angle estimation
- (U) \$ 103 Initiate and complete Mode S integration study for AN/TPS-75 Radar Set
- (U) \$ 75 Initiate and complete analysis of solid state versus tube based transmitter for AN/TPS-75 Radar Set
- (U) \$ 494 Complete waveform and signal processor design and evaluation
- (U) \$ 762 **Total**

## (U) FY 1999 (\$ in Thousands):

- (U) \$ 448 Continue Track Before Detect for TMD
- (U) \$ 448 **Total**

Project 2314

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Exhibit R-2 (PE 0603617F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998				
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT					
4 - Demonstration and Validation		0603617F Command Control & Communications Applications		2314					
(U) B. Program Change Summary (\$ in Thousands)									
(U) Previous Presidents Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total					
(U) Appropriated Value	1,014	803	457	Cost					
(U) Adjustments to Appropriated Value	1,057	803		TBD					
a. Congressional Reductions	-22	-26							
b. Small Business Innovative Research	-21	-15							
c. Omnibus/Other Above Threshold Reprogramming									
d. Below Threshold Reprogramming									
e. Rescissions									
(U) Adjustments to Budget Years Since FY 1998 PB			-9						
(U) Current Budget Submit/FY 1999 President's Budget	1,014	762	448		TBD				
(U) Change Summary Explanation:									
Funding: N/A									
Schedule: N/A									
Technical: N/A									
(U) C. Other Program Funding Summary (\$ in Thousands):									
(U) RDT&E, AF (0602204F, Project 2002)	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total
(U) RDT&E, AF (0603789F, Project 4072)	8,775	10,046	9,529	9,314	10,863	10,344	10,598	Compl	Cost
(U) RDT&E, AF (0207412)	6,114	6,841	6,941	7,146	7,917	7,846	8,051	Cont	TBD
(U) Other Procurement, AF (0207412)	589	393	440	487	471	460	451	Cont	TBD
	9,947	28,178	26,782	24,973	19,860	20,845	20,925	Cont	TBD
Project 2314		Page 4 of 22 Pages		Exhibit R-2 (PE 0603617F)					

Project 2314

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2314

Applications

(U) D. Schedule Profile

	FY 1997		FY 1998		FY 1999			
	1	2	3	4	1	2	3	4
(U) Tube-based transmitter development								
(U) Tube-based transmitter panel performance and R&M testing			X		*	X		
(U) Tube-based versus solid-state eval					*	X		
(U) Develop waveform signal processor		*						
(U) Integrate Mode S into AN/TPS-75						*		
(U) Track Before Detect for TMD					*			

\* Indicates the start of an activity; X indicates the completion.

Project 2314

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Exhibit R-2 (PE 0603617F)

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

## 4 - Demonstration and Validation

PE NUMBER AND TITLE

0603617F Command Control &amp; Communications Applications

PROJECT

2314

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Primary Hardware Development	899	644	329
(U) Government Engineering Support	100	103	104
(U) Travel	15	15	15
(U) Total	1,014	762	448

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Hughes	C/CPFF	June 95	1,383	1,383	1,179	204	0	0	0	1,383
DSA	Tsk Ordr Agmt	Apr 97	905	905	0	470	403	0	0	905
TBD (TMD)	Tsk Ordr Agmt	Apr 98	TBD	1,258	0	0	80	338	840	1,258
<u>Support and Management Organizations</u>										
Rome Laboratory	In-house	N/A	n/a	n/a	6,419	190	194	110	Continuing	TBD
Miscellaneous	Various	Various	n/a	n/a	0	150	85	0	Continuing	TBD

Test and Evaluation Organizations - Not Applicable.

Government Furnished Property: Not Applicable.

Project 2314

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

4 - Demonstration and Validation

PE NUMBER AND TITLE

0603617F Command Control &amp; Communications

PROJECT

2314

Applications

## (U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	1,179	674	483	338	840	3,514
Subtotal Support and Management	6,419	340	279	110	Cont.	TBD
Subtotal Test and Evaluation	0	0	0	0	Cont.	TBD
<b>Total Project</b>	<b>7,598</b>	<b>1,014</b>	<b>762</b>	<b>448</b>	<b>Cont.</b>	<b>TBD</b>

Project 2314

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

4 - Demonstration and Validation

0603617F Command Control &amp; Communications

PROJECT

2317

## Applications

COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2317	Tactical Air Information Production & Distribution	530	2,648	3,080	3,156	3,184	3,233	3,294	Continuing	TBD
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification:** Transitions advanced communications to the Theater Deployable Communications (TDC) program in support of Theater Battle Management (TBM) command and control enhancements. The goal is to reduce the risk of transitioning advanced government or commercial off-the-shelf technology into military communications systems. Capabilities developed include modular programmable radio technologies and improvements to survivability, deployability, interoperability, and control of communications networks. The SPEAKeasy program core technologies and concept were demonstrated and transitioned to support the Joint Tactical Radio System (JTRS) JPO acquisition activities. This project will continue to develop and transition risk-reduced capabilities to airborne platforms required for these airborne platforms to effectively host the JTRS. Unmanned Airborne Vehicles (UAV)/Advanced Communications Node (ACN) platforms are intended to be the first so equipped, followed by other wider body aerospace platforms.

## (U) FY 1997 (\$ in Thousands):

- (U) \$ 500 Completed SSCN Phase II/Conduct Joint Demonstration.  
 - (U) \$ 30 Planned airborne-transportable radio development.  
 - (U) \$ 530 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$ 200 Extend SSCN capability to demonstrate capability in a rapid deployment scenario (SOCOM).  
 - (U) \$ 608 Initiate airborne-transportable radio wideband/multi-band antenna development.  
 - (U) \$1,000 Initiate airborne-transportable radio electromagnetic interference/compatibility research and test.  
 - (U) \$ 840 Initiate airborne-transportable radio wideband power amplifier development.  
 - (U) \$2,648 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$ 942 Continue airborne-transportable radio wideband/multi-band antenna development.  
 - (U) \$1,100 Continue airborne-transportable radio electromagnetic interference/compatibility research and test.  
 - (U) \$1,038 Continue airborne-transportable radio wideband power amplifier development.  
 - (U) \$3,080 Total

Project 2317

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2317

PE NUMBER AND TITLE

## Applications

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous Presidents Budget (FY 1998 PB)	530	2,808	3,142	
(U) Appropriated Value	569	2,808		
(U) Adjustments to Appropriated Value				
a. Congressional Reductions	-28	-107		
b. Small Business Innovative Research	-11	-53		
c. Omnibus/Other Above Threshold Reprogramming				
d. Below Threshold Reprogramming				
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-62	
(U) Current Budget Submit/FY 1999 President's Budget	530	2,648	3,080	TBD

## (U) Change Summary Explanation:

Funding: N/A

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) RDT&E, AF (0602702F, Project 4519)	12,286	11,550	12,455	10,861	12,389	111,959	12,260	Cont	TBD
(U) RDT&E, AF (0603789F, Project 2335)	4,121	4,636	4,119	4,269	5,414	5,363	5,511	Cont	TBD
(U) RDT&E, AF (0603789F, Project 4216)	0	1,420	2,441	2,564	2,768	2,834	2,919	Cont	TBD
(U) RDT&E, AF (0603238F, Project 4216)	2,187	0	0	0	0	0	0	0	TBD

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2317

## Applications

(U) D. Schedule Profile

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Secure Survivable Comm Net Phase II												
- Transition Plan				X								
- Development				X								
- Joint Demonstration				*				X				
- Demo for rapid deployment				*				X				
(U) Airborne-transportable Radio System Development												
- Planning				*		X						
- Antenna Development (Multiple Contracts)						*				X		
- Electro-magnetic Interference and Compatibility Research/Tests (Multiple Contracts)							*		X			
- Wideband power amplifier development						*						

\* Indicates the start of an activity; X indicates the completion.

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications Applications

2317

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Primary Hardware Development	190	2,348	2,780
(U) Government Engineering Support	50	60	60
(U) Travel	40	40	40
(U) Contractor Engineering Support	250	200	200
(U) Total	530	2,648	3,080

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
ESC	PD	Various	1,040	1,040	210	230	200	200	200	1,040
SOCOM	PD	Sept 96	592	592	392	0	200	0	0	592
TBD (Airborne-transportable radio support)	TBD	TBD	TBD	TBD	0	0	1,948	2,580	Cont.	TBD
<u>Support and Management Organizations</u>										
Rome Laboratory	In-house	n/a	n/a	TBD	12,153	139	300	300	Cont.	TBD
Miscellaneous	Various	Various	n/a	TBD	Cont.	161	0	0	Cont.	TBD

Test and Evaluation Organizations - Not Applicable

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
4 - Demonstration and Validation		0603617F Command Control & Communications Applications		2317	
Government Furnished Property: Not Applicable					
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u>					
	Total				
	Prior to	Budget	Budget	Budget to.	Total
	FY 1997	FY 1997	FY 1998	Complete	Program
Subtotal Product Development	602	230	2,348	Cont.	TBD
Subtotal Support and Management	12,153	300	300	Cont.	TBD
Subtotal Test and Evaluation	0	0	0	Cont.	TBD
Total Project	12,755	530	2,648	Cont.	TBD

Project 2317

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2321

## Applications

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2321 Tactical Battle Information Management	2,198	3,693	4,037	4,136	4,175	4,228	4,307	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: Designs and integrates improvements to system software and C3 applications modules via rapid prototyping and maximum user participation in all design activities. Current focus is the functional development and rapid prototyping of the Force Level Execution (FLEX) system, which will assist the combat operations personnel in an AOC to quickly replan or reallocate resources based on real-time threat inputs, including time critical targets (TCTs) and changes in the wartime scenario. The Joint Defensive Planner system will provide an automated system that aids the air defense duty officers in planning the integrated employment of Defensive Counter-Air and Active and Passive Defenses in conjunction with Offensive Counter-Air, to destroy or neutralize enemy aircraft and theater missiles. (The Joint Defensive Planner (JDP) was previously named the Defensive Planning and Execution (DPE) system. The change was made due to the decision by the Joint Standards Air Operations Software Configuration Control Board to make the Defensive Planning and Execution system the joint software application for theater air and missile defensive planning and monitoring.)

## (U) FY 1997 (\$ in Thousands):

- (U) \$1,433 Continued FLEX development and initiate integration into TBM Core Systems.  
 - (U) \$ 640 Initiated accelerated Joint Defensive Planner software development for joint use.  
 - (U) \$ 125 Completed TBM systems integration evaluations.  
 - (U) \$2,198 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$2,435 Complete initial FLEX integration into TBMCS V1.0 and TBMCS remote terminals.  
 - (U) \$1,169 Continue Joint Defensive Planner software development  
 - (U) \$ 89 Demonstrate FLEX airborne capabilities via TBMCS remote terminals (i.e. AWACS, JSTARS, ABCCC).  
 - (U) \$3,693 Total

Project 2321

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 4 - Demonstration and Validation

**0603617F Command Control & Communications Applications**

## PROJECT

2321

(U) FY 1999 (\$ in Thousands):

- |   |     |    |              |                                                                                                |
|---|-----|----|--------------|------------------------------------------------------------------------------------------------|
| - | (U) | \$ | 814          | Assess FLEX airborne application for integration into TBMCS remote terminals for airborne use. |
| - | (U) | \$ | 3,223        | Initiate integration of Joint Defensive Planner as a TBMCS application.                        |
| - | (U) | \$ | <b>4,037</b> | <b>Total</b>                                                                                   |

(U) **B. Program Change Summary (\$ in Thousands)**

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total Cost</u>
(U) Previous Presidents Budget (FY 1998 PB)	2,385	3,894	4,118	TBD

(U) Appropriated Value

(U) Adjustments to Appr

### a. Congressional Reductions

**b. Small Business Innovative**

c. Omnibus/Other Above Threshold Re

d. Below Threshold Reprogramming

### e. Rescissions

(U) Adjustments to Budget Years Since FY 1998 PB

(U) Current Budget Submit/FY 1999 President's Budget

(U)	Change	Summary	Explanation:

Funding: FY97 BTR to PE 0305176F to support Combat Survivor Evader Locator requirement.

**Schedule: N/A**

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>To Compl</u>	<u>Total Cost</u>
(U) RDT&E, AF (0603789F, Project 2335)	4,121	4,636	4,119	4,269	5,414	5,363	5,511	Cont	TBD
(U) RDT&E, AF (0207438F, Project 4287)	23,916	12,886	9,222	8,693	6,733	11,332	11,879	Cont	TBD
(U) RDT&E, AF (0603827C, Project 3261)	0	528	282	281	37	0	0		

Project 2321

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications

2321

## Applications

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) D. <u>Schedule Profile</u>												
(U) TBM Systems Integration Evaluation		X										
(U) FLEX												
- TBMCS V1.0 integration						X						
- Airborne application					*							
(U) Joint Defensive Planner software development					*							
- Evolutionary Prototype (EP) #1						X						
- EP #2								X				
- EP #3									X			
- Advanced Technology Demonstration										X		
- Functional Validation Model #1											X	
- Initial integration into TBMCS												*
(U) Sensor Management Development (2Q00)												

\* Indicates the start of an activity; X indicates the completion.

Project 2321

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications Applications

2321

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Software Development	1,573	2,958	3,337
(U) Government Engineering Support	250	310	200
(U) Travel	150	150	200
(U) Contractor Engineering Support	225	275	300
(U) <b>Total</b>	2,198	3,693	4,037

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Logicon	C/CPFF	June 94	8,439	8,439	6,033	631	1,775	0	0	8,439
PRB Assoc.	C/CPAF	Feb 97	7,600	7,600	0	650	750	2,600	3,600	7,600
TBD (Sensor Mgmt)	TBD	Apr 00	TBD	7,100	0	0	0	0	7,100	7,100
<u>Support and Management Organizations</u>										
Rome Laboratory	In-house	n/a	n/a	TBD	27,423	604	754	944	Cont	TBD
Miscellaneous	Various	Various	n/a	TBD	0	313	414	493	Cont	TBD

Test and Evaluation Organizations - Not Applicable

Project 2321

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)					DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE					
4 - Demonstration and Validation		0603617F Command Control & Communications Applications			2321		
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u>							
Government Furnished Property: Not Applicable							
		Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
	Subtotal Product Development	6,033	1,281	2,525	2,600	10,700	23,139
	Subtotal Support and Management	27,423	917	1,168	1,437	Cont	TBD
	Subtotal Test and Evaluation	0	0	0	0	Cont	TBD
	Total Project	33,456	2,198	3,693	4,037	Cont	TBD

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603617F Command Control & Communications Applications								3804	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3804	Tactical Air Forces Systems Integration	250	129	205	225	229	240	246	Continuing	TBD	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	
<p>(U) <b>A. Mission Description and Budget Item Justification:</b> Provides systems engineering and integration support to the Combat Air Forces (CAF) or to other development efforts. Project addresses integration and interoperability issues associated with TBM General Officers Steering Group (GOSG) directed efforts, makes recommendations, identifies deficiencies, and establishes requirements for development efforts.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$ 100 Prepared for AOC Defensive Planning Development.</li> <li>- (U) \$ 150 Completed Sensor Management analysis.</li> <li>- (U) \$ 250 <b>Total</b></li> </ul> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$ 75 Support and Analyze TBMCS Theater Integration</li> <li>- (U) \$ 54 Evaluate Joint Defensive Planner Prototype</li> <li>- (U) \$ 129 <b>Total</b></li> </ul> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$ 105 Evaluate Joint Defensive Planner advanced technology demonstration prototype</li> <li>- (U) \$ 100 Initiate transition of Joint Defensive Planner System to TBMCS</li> <li>- (U) \$ 205 <b>Total</b></li> </ul>											

Project 3804

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BUDGET ACTIVITY		PE NUMBER AND TITLE		DATE	PROJECT
RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		0603617F Command Control & Communications Applications		February 1998	3804
<b>4 - Demonstration and Validation</b>					
<b>(U) B. Program Change Summary (\$ in Thousands)</b>					
(U) Previous Presidents Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total	
(U) Appropriated Value	250	145	209	Cost	
(U) Adjustments to Appropriated Value	267	145		TBD	
a. Congressional Reductions	-12	-13			
b. Small Business Innovative Research	-5	-3			
c. Omnibus/Other Above Threshold Reprogramming					
d. Below Threshold Reprogramming					
e. Rescissions					
(U) Adjustments to Budget Years Since FY 1998 PB			-4		
(U) Current Budget Submit/FY 1999 President's Budget	250	129	205		TBD
<b>(U) Change Summary Explanation:</b>					
Funding: N/A					
Schedule: N/A					
Technical: N/A					
<b>(U) C. Other Program Funding Summary (\$ in Thousands):</b> Not Applicable.					

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
BUDGET ACTIVITY		PE NUMBER AND TITLE		DATE		PROJECT			
4 - Demonstration and Validation		0603617F Command Control & Communications Applications		February 1998		3804			
(U) D. <u>Schedule Profile</u>									
(U) Analysis of TBM Core Systems theater integration		1	2	3	4	1	2	3	4
(U) Sensor Management Analysis									
(U) Defensive Planning and Execution - Develop Plan		*							
(U) TBM Force Level System prototype Evaluations									
- AOC Combat Operations		X							
- Joint Operations		*							
- TBMCS Integration							X		
(U) Joint Defensive Planner Evaluation/Integration into TBMCS									
- Evaluate JDP Prototype									X
- Transition to TBMCS									*

\* Indicates the start of an activity; X indicates the completion.

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603617F Command Control &amp; Communications Applications

3804

### (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Systems Engineering	189	120	180
(U) Government Engineering Support	11	9	25
(U) Contractor Engineering Support	50	0	0
(U) <b>Total</b>	<b>250</b>	<b>129</b>	<b>205</b>

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
----------------------------------------------	-----------------------------------------	--------------------------	-------------------------	--------------------	------------------------	----------------	----------------	----------------	--------------------	---------------

Product Development Organizations - Not Applicable.

#### Support and Management Organizations

MITRE	SS/TO&P	Various	n/a	TBD	2138	189	120	180	Continuing	TBD
Rome Laboratory	In-house	n/a	n/a	TBD	132	11	9	25	Continuing	TBD
Miscellaneous	Various	Various	n/a	TBD	Cont.	50	0	0	Continuing	TBD

Test and Evaluation Organizations - Not Applicable.

Government Furnished Property: Not Applicable.

Project 3804

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RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

February 1998

PE NUMBER AND TITLE

0603617F Command Control &amp; Communications

**3804**

	<u>Total</u>	<u>Budget</u>	<u>Budget</u>	<u>Budget</u>	<u>Budget to</u>	<u>Total</u>
	<u>Prior to</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Complete</u>	<u>Program</u>
Subtotal Product Development	0	0	0	0	Continuing	TBD
Subtotal Support and Management	2270	250	129	205	Continuing	TBD
Subtotal Test and Evaluation	0	0	0	0	Continuing	TBD
<b>Total Project</b>	<b>2270</b>	<b>250</b>	<b>129</b>	<b>205</b>	<b>Continuing</b>	<b>TBD</b>

PE NUMBER: 0603742F

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PE TITLE: Combat Identification Technology

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603742F Combat Identification Technology								2597	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2597	Noncooperative Identification Subsystems	1,936	1,276	6,177	6,428	6,491	6,578	6,754	Continuing	Continuing	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

\* Classified information can be provided upon request.

**(U) A. Mission Description and Budget Item Justification**

(U) U.S. Combat Air Forces have a critical requirement to positively identify enemy, friendly, and neutral aircraft and battlefield equipment. Timely and reliable Combat Identification (CID) reduces fratricide, and enables the battlefield commander to effectively manage and control the battle. Such consequences have fostered the following operational requirements for CID systems:

- High confidence of ID
- All weather capable
- Worldwide operations capable
- High probability of ID (friend, foe, and neutral)
- Day/night capable

This program is in budget activity 4 - The PE includes advanced technology demonstrations that help transition technologies from laboratory to operational use.

**(U) Acquisition Strategy:** The Combat ID Technologies program element develops, demonstrates, and transitions promising target identification technologies to meet the requirements cited above. Project 2597 funds the Ultra-High Range Resolution (UHRR) radar; a Non-Cooperative Target Recognition (NCTR) technique code named HAVE CENTAUR. The HAVE CENTAUR program development was awarded under a competitive bid process. Additionally, Project 2597 will focus on developing and demonstrating the most promising Air-to-Ground Combat ID techniques. Future Air-to-Ground CID technology developments will be contracted for under a competitive Request For Proposal (RFP) process. Current and planned accomplishments by fiscal year are as follows:

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603742F Combat Identification Technology	2597	
(U) FY 1997 (\$ in Thousands):			
- (U) \$1,280	Continued UHRR ground-to-air ID classifier testing and began air-to-air testing on the aircraft testbed		
- (U) \$133	Funded an Air-to-Air Correlation Accuracy requirements study		
- (U) \$523	Funded CID Integrated Management Team for overall management of Air Force CID programs. Supports related studies/demos to increase warfighters CID capabilities and funded Air Traffic Control Radar Beacon System/Identification Friend or Foe (IFF)/ Mark XII System Program Office (AIMSPO) support of potential next generation IFF equipment integration with current IFF capabilities.		
- (U) \$1,936	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$200	Conduct HAVE CENTAUR algorithm validation and data analysis, continue synthetic target database development and provide test support.		
- (U) \$300	Air-to-Ground (A/G) CID study - Define and quantify A/G CID requirements. Establish CID systems needed in multiple mission areas.		
- (U) \$150	Funds work on Identification Data Combining Process (IDCP) algorithm and program to set up a NATO standard for correlating and fusing identification data onboard AWACS aircraft.		
- (U) \$626	Funds CID Integrated Management Team for management of Air Force CID programs and conducting related studies/demos to increase warfighter's CID capabilities. Also funds AIMSPO support of next generation IFF equipment integration with current IFF capabilities.		
- (U) \$1,276	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,200	Conduct HAVE CENTAUR algorithm validation, continue synthetic target database development, and provide test support.		
- (U) \$1,200	Continue development and demonstration planning of most promising air-to-ground identification techniques for reduced battlefield fratricide and enhanced mission performance.		
- (U) \$800	Investigate cruise missile target ID techniques to counter the emerging cruise missile threat		
- (U) \$350	Air-to-Ground (A/G) CID study. Analyze selected systems to determine mission effectiveness and optimal A/G CID system architecture.		
- (U) \$627	Funds CID Integrated Management Team for overall management of Air Force CID programs. Supports related studies/demos to increase warfighter's CID capabilities and funds AIMSPO support of next generation IFF equipment integration with current IFF capabilities		
- (U) \$6177	Total		

Project 2597

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603742F Combat Identification Technology	2597	

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous President's Budget (FY1998 PB)				
(U) Appropriated Value	4059	1395	6,401	
(U) Adjustments to Appropriated Value	4225	1395		
a. Cong Reductions	-88	-91		
b. SBIR	-78	-28		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming	-2120			
e. Recissions	-3			
(U) Adjustments to Budget Years Since FY 1998 PB			-224	
(U) Current Budget Submit/FY1999 President's Budget	1,936	1,276	6,177	TBD

(U) Change Summary Explanation:

Funding: FY97 funding reductions due to General Congressional Reductions, Section 8136 (-\$84K), Section 8138 (-\$4K); and SBIRs (-\$78K)

Reprogrammed to another AF program (-\$2,120K), FY97 Supplemental Appropriations (-\$3K)

FY98 funding reductions due to General Congressional Reductions, Section 8041 (-\$46K), Section 8043 (-\$21K), Section 8048 (-17K) and Economic Assumptions (-\$7K); and SBIR (-\$28K).

FY98 funding pending reprogramming to higher priority programs (-\$9K)

FY99 funding reprogrammed to higher priority programs (-\$224)

Schedule: Initial HAVE CENTAUR capability will be delivered in the upcoming software delivery, with a more robust capability scheduled for the follow on suite.

Technical: Development of synthetic targets for database will need to continue through FY01. As development of the synthetic models mature, they will be tested using the HAVE CENTAUR algorithms and their performance will be validated.

(U) C. Other Program Funding Summary (\$ in Thousands) None.

Project 2597

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

4 - Demonstration and Validation

0603742F Combat Identification Technology

PROJECT

2597

(U) D. Schedule Profile: Item 2 of the schedule reflects the SPO radar schedule, other categories refer to Have Centaur

		FY 1997				FY 1998				FY 1999			
		1	2	3	4	1	2	3	4	1	2	3	4
1. (U) H/W EMD/Production (Radar)													
EMD (Start 1QFY95)													
Flight Test	*									X			
LRIP & Production Begins											X		

1. (U) H/W EMD/Production (Radar)

EMD (Start 1QFY95)

Flight Test

LRIP &amp; Production Begins

2. (U) Classifier Dev/Qual

Ground-to-Air Test #2 (Complete)

Airborne Data Collection

Classifier/Target Library

Flight Demo

3. (U) Radar Software Upgrade Build

4. (U) Other: H/W EMD complete: 1QFY00

LRIP start: 2QFY99 Finish: 2QFY00

Production Complete: 4QFY04

OFF PDR

OFF CDR

\* denotes completed events

X denotes planned events

Project 2597

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603742F Combat Identification Technology

2597

(U) A. Project Cost Breakdown (\$ in Thousands):

Product Development	FY 1997	FY 1998	FY 1999
Support and Management	1834	1276	4527
Test and Evaluation	0	0	1000
Total	102	0	650
	1936	1276	6177

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands):Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
-------------------------------------------------	--------------------------------------------------	--------------------------------	-------------------------------	--------------------------	------------------------------	---------	---------	-------------------	-----------------------	------------------

Product Development Organizations

Hughes A/C Co	CPFF	Sep 92	35529	35529	30354	125		1400	2900	34779
Westinghouse Elec Co	CPFF	Aug 93	1780	1780	1780					1780
McDonnell Douglas	AF616	Aug 94	3550	3550	2750	800				3550
Veda, Inc.	CPFF	Aug 94	12811	12811	12059	162	370	320		12911
National Air Intel Center	AF616	Annually	3329	3329	3329					3329
USAF Wright Laboratory		N/A	3260	3260	2077	255	50	150	700	3232
Combat ID IMT Studies	AF616/ AF185	Various				133	300	2345	Continue	TBD

Project 2597

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

### 0603742F Combat Identification Technology

2597

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations										
Georgia Tech Research Institute (GTRI)	CPFF	Aug 94	1978	1978	1978	0	0	0	0	1978
Demeco, Inc.	CPFF	Aug 94	9004	9004	6604	0	0	1000	1400	9004
USAF Combat ID IMT		N/A				359	556	312	Continue	TBD
Test and Evaluation Organizations										
3246 <sup>th</sup> Test Wing, Eglin AFB, FL	Mixed, CPF, MIPRS	N/A	3769	3769	2217	102	0	650	800	3769
544 <sup>th</sup> Range Group, Nellis AFB, NV										
Government Furnished Equipment: None										
Subtotal Product Development					52349	1475	720	4215	Continue	TBD
Subtotal Support and Management Organizations					8582	359	556	1312	Continue	TBD
Subtotal Test and Evaluation Organizations					2217	102	0	650	800	3769
Total Project					63148	1936	1276	6177	Continue	TBD

Project 2597

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE		February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE					PROJECT				
4 - Demonstration and Validation		0603790F NATO Cooperative Research and Development					NATO				
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
COST (\$ In Thousands)											
NATO Nato Coop R&D		9,767	10,414	11,117	11,291	11,913	12,026	12,255	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

\*This program element was previously funded under OSD PE 0603790D which will be used to fund DoD-wide priority agreements. FY97 is the first year of funding for PE 0603790F.

(U) **A. Mission Description and Budget Item Justification**

These funds will be used to help implement international cooperative research, development, and acquisition (ICRD&A) agreements with NATO and major non-NATO allies (Australia, Egypt, Israel, Japan, and Korea). The program implements the provisions of Title 10 U.S. Code, Section 2350a on NATO Cooperative Research and Development (R&D). The program was established to improve what Congress perceived as inadequate cooperation among NATO nations, and later major non-NATO allies, in research, development, and production. The legislation authorized funds to significantly improve US and allied conventional defense capabilities by leveraging the world's best defense technologies, eliminating costly duplication of research and development efforts, accelerating the availability of defense systems, and promoting US and allied interoperability or commonality. These funds will help implement Air Force agreements that directly support the Air Force and DoD Science and Technology community, Major Commands, Joint Vision 2010, and the Air Force's Strategy of Global Engagement. The planned program is shown below. The final program will be reported separately as required by Title 10 U.S. Code, Section 2350a(f). This program element funds the implementation of Air Force ICRD&A agreements in (1) Basic Research (2) Applied Research (3) Advanced Technology Development (4) Demonstration and Validation (5) Engineering and Manufacturing Development and (6) RDT&E Management Support. This PE is designated in Budget Activity 4 because most of the ICRD&A projects support specific systems, include all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology and help expedite technology transition from the laboratory to operational use.

(U) **Acquisition Strategy:**

A principal goal of the NATO Cooperative R&D program is to effectively utilize the aggregate resources invested by the US and our allies in conventional defense R&D. This program element provides the critical funding incentive needed to pursue ICRD&A agreements and helps to (a) leverage USAF and allied resources through cost sharing and economies of scale; (b) exploit the best US and allied technologies for equipping coalition forces; (c) demonstrate areas of commonality or interoperability with our allies; and (d) accelerate the availability of defense technologies and systems. Candidate projects are reviewed and approved by the USD(A&T). An international agreement defining project objectives, responsibilities and costs is required prior to release of funds. To obtain these funds and ensure service commitment, projects are selected from existing or new RDT&E programs funded in the Future Years Defense Plan (FYDP). Project offices must show matching funds and contributions from associated program elements and equitable allied funding. As appropriate, funding responsibility for out-year requirements and follow-on efforts are transferred to the project office and associated program elements. Most contracts are awarded after full and open competition.



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BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT
	0603790F NATO Cooperative Research and Development		NATO
4 - Demonstration and Validation			
(U) <u>FY 1997 (\$ in Thousands)</u> : Funds were allocated for continuing projects initiated in FY95 and FY96 under PE 0603790D and new projects.			
(U) <u>Continuing Projects Initiated in FY95 and FY96 Under PE 0603790D</u> :			
- (U)	\$475	<b>Image Information Reformatter (IIR)</b> (Rome Laboratory/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems. In FY97 phase one definition activities were completed and a phase two program to build and demonstrate the ADM-IIR was defined.	
- (U)	\$2,700	<b>Experimental Air Operations Center (EAOC)</b> (Electronics Systems Center/United Kingdom) - Cooperative research and advanced development project into an EAOC using the US Contingency Theater Automated Planning System (CTAPS) as a baseline. In FY97 the project conducted research and advanced development into key command and control (C2) areas of Combined Air Operations Center (CAOC) functionality: the US developed an Enhanced Monitoring and Execution tool and conducted studies on Enhanced Human Computer Interfaces (HCI); the US and United Kingdom jointly developed a Battle Space Display (BSPD); and the United Kingdom provided a Master Battle Planning (MBP) tool and War Gaming/Exercise support. The MBP component was well received at the Kenney Battle Lab Initiative and was selected to participate in EFX-98. Anticipate completing development of this module and fielding in Theater Battle Management Core Systems (TBMCS) version 1.1.	
- (U)	\$2,742	<b>Vista Warrior</b> (Armstrong Laboratory/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY97 the project demonstrated the monocular Helmet-Vehicle Interface (HVI), and the corresponding improvements in reliability, safety and commonality, with an advanced HMT/D in an F-15C; evaluated alternative control and display technologies for use in advanced cockpits; initiated assessment of the utility of color symbology for HMT/Ds in the US Synthesized Immersion Research Environment (SIRE) facility; conducted risk reduction studies on eye tracker technologies; and developed method to perform a quick look assessment of biodynamic inference suppression algorithm for the Joint Helmet-Mounted Cueing System Engineering and Manufacturing Development program.	
- (U)	\$800	<b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Phillips Laboratory/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY97 the project developed techniques to exploit Global Positioning System-Meteorological (GPS-Met) satellite data to validate and drive sensor-driven ionosphere specification models; incorporated Defense Meteorological Satellite Program (DMSP) sensor data into displays to alert C3I-system operators of disruptive ionospheric scintillation conditions; and assessed the viability of using UK ionospheric tomography data for large area ionospheric specification. Also in FY97, the project developed improved ground-based sensing techniques and visualization displays for specifying and forecasting ionospheric scintillation conditions that could lead to C3I system disruptions and outages.	

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Exhibit R-2 (PE 0603790F)

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PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603790F NATO Cooperative Research and Development

NATO

- (U) \$800

**Future Multiband, Multiwaveform Modular Tactical Radio (FM3TR)** (Rome Laboratory/France, Germany, United Kingdom) - Cooperative project to provide international capabilities in the area of interoperable and quickly reconfigurable communication systems using the US Speakeasy system as the baseline. In FY97-98 the project will finalize the first phase initiative of integrating the FM3TR test waveform. Demonstration and test plans are in their final phases or completed, and the US has modified the first phase of the Speakeasy system to incorporate the FM3TR waveform. In addition, the FM3TR waveform will also be hosted onto a demonstration model of the Speakeasy phase II system. NATO Cooperative R&D provided the funds necessary for the preparation of a successful test, integration and initial international demonstration. After a series of international demonstrations over the next year and a half, a future effort will target specific technology development and architecture modifications made evident by the initial first phase endeavor.

- (U) \$150

**Single Mode Optical Fibers for Array Imaging and for Environmental Sensing** (Phillips Laboratory/United Kingdom) - Cooperative project to enhance the performance of single mode (SM) optical fibers for ultra-high angular resolution imaging in support of space surveillance needs. In FY97 the project completed the SM fiber optical link demonstrator and identified key parameters for the next generation link. The US developed the optical and electronic control loop for the link and the UK developed the prototype environmental control loop. The waveform sensing strategy was discussed in detail. The US delivered the first 4 cores multi-core SM fiber and the UK delivered the first 6 cores multi-core SM fibers. Both prototypes underwent intensive tests.

(U) New Projects:

- (U) \$200

**Dense Metal Case Penetrating Weapon (DMCPW)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead, that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstration will be through subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY97 the project identified the most promising DMCPW warhead concepts and initiated US PAVEWAY III flight demonstration guidance kit and United Kingdom weaponization design studies.

- (U) \$500

**Free Piston Shock Tunnel/High Enthalpy Goettingen Project** (Arnold Engineering and Development Center/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US Free Piston Shock Tunnel (FPST) and Germany's High Enthalpy Goettingen (HEG) facilities. In FY97 details of test conditions and the test schedule were established with Germany. Common mechanical and electrical interfaces between the German HEG and US FPST facilities for diagnostics equipment were determined. The FPST facility was configured for the initial calibration tests.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

**4 - Demonstration and Validation**

**0603790F NATO Cooperative Research and Development**

**NATO**

- (U) \$750 **Programmable Integrated Ordnance Suite (PIOS)** (Wright Laboratory/United Kingdom) - Cooperative project to develop and demonstrate integrated missile ordnance technologies, including imaging infrared target detection devices (TDD), mass-focused or directional warheads, and advanced initiation fireset. The primary goal is to improve counter-air lethality against advanced fighter, bomber, helicopter, and cruise missile targets. In FY97 the project focused on developing the modeling and simulation toolset to perform engineering design trades of concept TDD and warheads. Toward the end of FY97 the simulations were exercised to evaluate concept TDD and warhead technologies to assess lethality performance and technical risk.
- (U) \$200 **Adaptive Flexible Structures for Air Vehicle Applications** (Wright Laboratory/Australia) - Cooperative project to analyze, develop and demonstrate an approach to suppressing buffet load-induced vibrations on vertical tail aircraft. In FY97 the project attached a US developed buffet load alleviation (BLA) control system to an F/A-18 test aircraft, installed the aircraft in Australia's International Follow-On Structural Testing Project (IFOSTP) facility, and began testing the BLA control system. In FY98, testing of the BLA control system will be completed, the performance and benefits of the BLA control system will be determined, and reports will be prepared documenting the development and test results of the BLA control system.
- (U) \$450 **Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons** (Wright Laboratory/Israel) - Cooperative project to develop rapid, inexpensive construction process to significantly increase the strength and resistance of existing or new conventional concrete and mason structures to terrorist vehicle bombs or tactical ballistic missile threats. Meets requirement to upgrade mission critical air base structures at both contingency and fixed bases, thereby reducing the need for new military construction. In FY97 the project selected, evaluated and tested advanced composite materials, application processes, and conducted structural component blast tests in the US. Concepts for strengthening masonry walls with composites, window retrofits, geotextile curtains, energy absorbing exterior panels, and joint reinforcement retrofits were investigated.
- (U) \$9,767 **Total**

(U) FY 1998 (\$ in Thousands):(U) Continuing Projects Initiated in FY95 and FY96 Under PE 0603790D:

- (U) \$400 **Image Information Reformatter (IIR)** (Air Force Research Laboratory (formerly Rome Laboratory)/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems. In FY98 Air Force Research Laboratory will competitively award a procurement contract to develop and demonstrate the US portion of the Phase Two ADM-IIR capability. The French Ministry of Defense will make a similar award to a French company. The core hardware portions of the ADM-IIR will be based on commercial-off-the-shelf equipment with some unique interfacing hardware and software.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	February 1998 NATO	
- (U) \$500	<b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY98 the project will expand the coverage area for which C3I system outage forecasts and alerts can be provided to include the South America and the Atlantic regions. In addition, the project will initiate efforts to couple the sensor-driven Parameterized Ionosphere Specification Model (PRISM) to a United Kingdom analytic ray tracing code for radio wave propagation prediction applications; and develop algorithms to couple Global Position System-Meteorological (GPS-Met) satellite data into PRISM.		
- (U) \$150	<b>Single Mode Optical Fibers for Array Imaging and for Environmental Sensing</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/United Kingdom) - Cooperative project to enhance the performance of single mode optical fibers for ultra-high angular resolution imaging in support of space surveillance needs. In FY98 the project will complete the laboratory tests of the US and UK prototype Multi-Core Single Mode Fibers (MCSMF) and move to field tests of the two prototypes. The project will evaluate which prototype is the best in terms of cost, reliability, etc. MCSMFs offer the potential for transmitting light and images more efficiently.		
- (U) \$2,300	<b>Vista Warrior</b> (Air Force Research Laboratory (formerly Armstrong Laboratory)/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY98 the project will demonstrate Helmet-Vehicle Interface (HVI) for binocular HMT/Ds; develop color image source technology for a monocular HMT/D for use in fast-jets for air-to-air and air-to-ground missions; begin development of flight-worthy eye tracker for airborne eye pointing/targeting; and finalize selection of advanced controls and displays for demonstration in aircraft.		
	(U) Continuing Projects Initiated in FY97 Under PE 0603790F:		
- (U) \$1,100	<b>Dense Metal Case Penetrating Weapon (DMCPW)</b> (Air Force Research Laboratory (formerly Wright Laboratory)/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstrations will be through subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY98 the project will complete preliminary design of the DMCPW warhead, US PAVEWAY III flight demonstration guidance kit, and United Kingdom weaponization design studies; begin DMCPW detailed design, development, and ground testing; and initiate procurement of PAVEWAY III flight demonstration guidance kits.		

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	NATO	
- (U)	\$550	<p><b>Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons</b> (Air Force Research Laboratory (formerly Wright Laboratory)/(Israel) - Cooperative project to develop rapid, inexpensive construction process to significantly increase the strength and resistance of existing or new conventional concrete and mason structures to terrorist vehicle bombs or tactical ballistic missile threats. Meets requirement to upgrade mission critical air base structures at both contingency and fixed bases, thereby reducing the need for new military construction. In FY98 the project will continue to evaluate and select materials for further testing; test modules and components of structures under blast loading in the US and Israel; and conduct tests on complete structures in Israel. Systems validated on complete structures will include masonry wall reinforcement with composite bonding, geotextile "catch" curtains, energy absorbing window frames, and sacrificial exterior panels. Validated systems will be finalized and issued to users via field manual.</p>	
- (U)	\$500	<p><b>Free Piston Shock Tunnel/High Enthalpy Goettingen Project</b> (Arnold Engineering and Development Center/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US Free Piston Shock Tunnel (FPST) and Germany's High Enthalpy Goettingen (HEG) facilities. In FY98 FPST facility calibration tests and the first model will be done. Tests of the first two model configurations in the HEG will be completed. As test data becomes available, computational fluid dynamics analysis will begin. Continued development of non-intrusive diagnostics techniques will be a major part of the test programs at both wind tunnels.</p>	
- (U)	\$500	<p><b>Programmable Integrated Ordnance Suite (PIOS)</b> (Air Force Research Laboratory (formerly Wright Laboratory)/United Kingdom) - Cooperative project to develop and demonstrate integrated missile ordnance technologies, including imaging infrared target detection devices (TDD), mass-focused or directional warheads, and advanced initiation fireset. The primary goal is to improve counter-air lethality against advanced fighter, bomber, helicopter, and cruise missile targets. Technical risk areas identified in FY97 will be subjected to more detailed engineering analyses in FY98 to identify design approaches that mitigate risk. The FY98 deliverable will be a preliminary design of an integrated counter air ordnance suite with support engineering rationale and lethality performance predictions.</p>	
		<p>(U) <u>Continuing Projects Initiated in FY97 Under PE 0603790D:</u></p>	
- (U)	\$1,150	<p><b>Regional/Sector Air Operations Center (R/SAOC) Modernization Program</b> (Electronic Systems Center/Canada) - Cooperative project to modernize existing R/SAOC computing and display capabilities to better support designated North American Aerospace Defense (NORAD) Command missions. In FY98 the project will continue integrating R/SAOC with the Theater Battle Management Core System (TBMCS), Global Command and Control System (GCCS), and the Defense Information Infrastructure/Common Operating Environment (DII/COE).</p>	

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BUDGET ACTIVITY	PE NUMBER AND TITLE		
4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	February 1998	NATO
-	(U) \$50	<b>Aftbody/NozzleAeroacoustics Project (ANAP)</b> (Air Force Research Laboratory (formerly Wright Laboratory)/United Kingdom) - Cooperative project to develop jet screech frequency and amplitude prediction capabilities. Goal is to combine state-of-the-art US modeling techniques with unique United Kingdom anechoic chamber data to develop a tool which can be used for analysis and design tradeoffs. Nozzle screech has been shown to destroy exhaust structural components, and is particularly damaging in twin-jet configurations. Very limited technical data is currently available in this area. In FY97, acoustic data was obtained for a single round jet (hot, cold, with and without forward flight) in the United Kingdom facility at Pyestock. In FY98, efforts will focus on obtaining twin-jet screech data in the United Kingdom, and on extending the analysis capabilities of the screech tool to twin-jet configurations. When complete, this will represent the only twin-jet predictive capability available (numerical or analytical). In addition, work will continue towards analysis of existing data, and incorporation of new findings/physics into the existing jet pool.	
	(U) New Projects:		
	(U) \$284	<b>Cooperative Research and Development Efforts in Imaging Spectrometer Development</b> (Arnold Engineering and Development Center/Canada) - Cooperative project to pool the spatial and spectral advances of both the US and Canada, and develop a high-resolution sensor system capable of characterizing signatures of rockets and aircraft, for drug interdiction, and identifying trace quantities of a broad spectrum of gases in the environment. In FY98 the project will survey available components and state-of-the-art technology for focal plane arrays, interferometers, and data acquisition hardware; begin the preliminary design for a high-resolution sensor system; and identify long lead components.	
	(U) \$100	<b>Effects of the Ionosphere on Communication and Surveillance Systems</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/France) - Cooperative project to leverage complementary equatorial ionospheric sensors and data to develop techniques for reliable warning of equatorial ionosphere disturbances that disrupt communication, surveillance, and Global Positioning System (GPS) navigation. This project will also incorporate a variety of French mid-latitude and equatorial ionosphere data and radio wave propagation data to validate US ionospheric specification and forecast models and radio wave propagation prediction techniques.	
-	(U) \$200	<b>Observations and Modeling for Space Weather</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/Germany) - Cooperative project involving US and German satellite sensors and experiments to provide coordinated observations and modeling of solar impact on space environment to forecast the global ionosphere and satellite drag. In FY98 the project will modify models to accept solar inputs; begin improvements in use of both currently available sensor data and future operational sensor data from sources such as the Defense Meteorological Satellite Program (DMSP) ultraviolet sensors.	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	NATO	
- (U)	\$200	<p><b>Cooperative Space Measurements</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/Germany) - Cooperative project to fly a Department of Defense developed space plasma detector aboard a German scientific spacecraft in 1999. Joint exchange and analysis of scientific data from this mission will be used to develop better descriptive and predictive models of the space environment, enhancing the reliability of space-based communications and navigation capabilities for the US and its allies. In FY98 the Air Force Research Laboratory will fabricate, test, and deliver the flight unit to the German spacecraft integrator, as well as support spacecraft integration and testing.</p> <p><b>Project Refractive Turbulence</b> (Air Force Research Laboratory (formerly Phillips Laboratory)/Australia) - Cooperative project to obtain accurate, statistically significant, world wide turbulence measurements. The turbulence data base is essential to support studies that evaluate atmospheric refraction propagation effects on the design/performance of the Airborne Laser (ABL) and the Defense Airborne Reconnaissance Office's (DARO's) high-altitude Unmanned Aerial Vehicles (UAVs) communication and surveillance systems. Data acquired also has direct applicability in assessing refractive effects on performance of Airborne Warning and Control Systems (AWACS) and Joint Surveillance Target Attack Radar Systems (JSTARS). In FY98 the project will complete development of the faster response temperature sensor, adjust the software in the master program controlling data acquisition, and install a third turbulence probe on Australia's research aircraft. Mathematical analysis support will be provided for the two measurement campaigns in the western Mediterranean and southeast Australia.</p> <p><b>Metal Matrix Composites for Aerospace Applications</b> (Air Force Research Laboratory (formerly Wright Laboratory)/United Kingdom) - Cooperative project to improve the properties and processing of silicon carbide (SiC) - reinforced Titanium (Ti) - alloy and Aluminum (Al) - alloy metal matrix composites (MMCs) for aerospace applications. In FY98 the United Kingdom will initiate production of matrix-coated SiC fiber and conduct carbon coating deposition trials. The coated fibers will be provided to the US for characterization. A second project will determine the effect of fiber spacing defects on the transverse mechanical properties of fiber-reinforced Ti-alloy MMCs. Ti-alloy coated SiC fibers will be supplied by the United Kingdom and laboratory test samples will be prepared and tested in the US. A third project will improve the mechanical properties of SiC-reinforced Al alloy MMCs through the control of the distribution of the reinforcing particles.</p> <p><b>Advanced Combustor Chamber Concepts Program</b> (Air Force Research Laboratory (formerly Wright Laboratory)/France) - Cooperative project to develop and demonstrate a composite combustor structure suitable for use in advanced hypersonic weapon systems operating to Mach 8 on liquid hydrocarbon fuels. Resulting engines will be simpler, easier to cool, lower weight, and more durable than baseline metallic designs. In FY98 the project will establish a conceptual combustor design to determine thermal and structural requirements for each of the candidate materials; characterize each candidate material and corresponding fabrication technique; fabricate and begin testing sub-element panels at representative thermal and mechanical loads.</p> <p><b>Integrated Tactical Aircraft Control (ITAC) Program</b> (Air Force Research Laboratory (formerly Wright Laboratory)/France) - Cooperative project to develop, integrate and demonstrate critical flight control and flight management technologies that enable cooperative flight operations of a package comprised of manned and uninhabited combat air vehicles (UCAVs). The cooperative control architecture enables management and control of an integrated strike package by the aircrews in the combat aircraft. In FY98 the project will develop the appropriate documentation and technical definition in order to achieve a common understanding of system level requirements, program tasks and associated major program deliverables.</p>	
- (U)	\$180		
- (U)	\$100		
- (U)	\$300		
- (U)	\$450		

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4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	February 1998	NATO
- (U) \$400	<p><b>Anthropometric Accommodation in Crew Systems</b> (Air Force Research Laboratory (formerly Armstrong Laboratory)/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US (b) high quality methods for accommodation and interoperability assessment of crew systems and (c) methods for combining the data base with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY98 the project will collect the first half of the 3-D data sets in the United States and initiate the aircraft measurements.</p>		
- (U) \$400	<p><b>Aging Aircraft Life Prediction /Extension</b> (Air Force Research Laboratory (formerly Wright Laboratory)/Australia) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs of metallic structures, widespread fatigue damage including multiple-element damage and multiple site damage, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and sensors for structural health monitoring. In FY98 the project will document experience with widespread fatigue damage and composite patch repairs, develop analysis techniques for corrosion/fatigue, and evaluate composite patch repair analysis techniques.</p>		
- (U) \$350	<p><b>Structural Integrity of Aging Aircraft</b> (Air Force Research Laboratory (formerly Wright Laboratory)/Canada) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, widespread fatigue damage, life extension techniques for metallic structures, corrosion and its interaction with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development. In FY98 the project will document experience with widespread fatigue damage and evaluate composite patch repair analysis techniques.</p>		
- (U) \$250	<p><b>Airworthiness of Aging Aircraft</b> (Air Force Research Laboratory (formerly Wright Laboratory)/United Kingdom) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and structural life extension techniques for metal structures, such as the fastener-hole cold expansion process. In FY98 the project will document experience with corrosion/fatigue and composite patch repairs, develop analysis techniques for life enhancement, and evaluate composite patch repair analysis techniques.</p>		
- (U) \$10,414	Total		

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BUDGET ACTIVITY	PE NUMBER AND TITLE		
4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development		NATO
(U) FY 1999 (\$ in Thousands):			
-	(U) \$1,200	(U) Continuing Projects Initiated in FY96 under PE 0603790D:	
		<b>Image Information Reformatter (IIR)</b> (Air Force Research Laboratory/France) - Cooperative project to define, develop and demonstrate an Advanced Development Model (ADM) - IIR for the purpose of demonstrating interoperability among allied tactical imagery reconnaissance collection and ground systems. In FY99 anticipate completion of initial ADM design and establishment of team of French and US contractors to work the common development of IIR core computer programs. Initiate demonstration activities using interfaces provided by a single country and then replicate this for the other country.	
-	(U) \$400	<b>Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to leverage complementary ionospheric sensors and data to develop capabilities for timely warning of ionospheric disturbances that disrupt C3I systems. In FY99 the project will expand the coverage area for which C3I system outage forecasts and alerts can be provided to include the North Africa/Middle East region; the potential for exploiting Global Position System-Meteorological (GPS-Met) satellite data to drive near real-time specifications of the ionosphere will be assessed; and the use of multiple mid- and high latitude ionospheric sensor data to improve the accuracy of space surveillance radar. Range corrections will be validated.	
-	(U) \$1,000	<b>Vista Warrior</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and evaluate advanced helmet-mounted tracker and display (HMT/D) technologies, multi-sensory virtual interface concepts, and virtual display and control devices for incorporation into advanced aircraft. In FY99 the project will select the image source technology for color HMT/Ds; evaluate advanced controls and displays in a fast-jet aircraft; conduct laboratory assessment of eye tracker technologies; and demonstrate color monocular HMT/D.	
		(U) Continuing Projects Initiated in FY97 under PE 0603790F:	
-	(U) \$1,697	<b>Dense Metal Case Penetrating Weapon (DMCPW)</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to develop and demonstrate technology for a dense metal penetrating warhead, that is compatible with guidance kits such as PAVEWAY III and the Joint Deep Attack Munition (JDAM). This technology offers a two-fold increase in hard target defeat over current warhead case designs. The warhead will be compatible for carriage and release with future smaller aircraft, and stand-off weapons such as cruise missiles. Technology demonstration will be through subscale and full scale dynamic ground impact testing (sled and/or powder gun) with an option for flight demonstrations using PAVEWAY III guidance kits. In FY99 the project will complete the DMCPW warhead detailed design, development, and sled tests; delivery of US PAVEWAY III flight demonstration guidance kits; integrate the DMCPW warhead and PAVEWAY III guidance kit and flight test from an F-16 aircraft.	

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BUDGET ACTIVITY	PE NUMBER AND TITLE			
<b>4 - Demonstration and Validation</b>	<b>0603790F NATO Cooperative Research and Development</b>		<b>February 1998</b>	<b>NATO</b>
- (U) \$200	<b>Free Piston Shock Tunnel/High Enthalpy Goettingen Project</b> (Arnold Engineering and Development Center/Germany) - Cooperative project to significantly reduce the cost of acquiring technologies and ground test capabilities for the development of hypersonic flight systems by combining the complementary efforts of the US Free Piston Shock Tunnel (FPST) and Germany's High Enthalpy Goettingen (HEG) facilities. In FY99 the project will complete FPST testing on the second and third model configurations; complete HEG testing on the third model; complete computational fluid dynamics analysis on all data; and complete final report.			
	(U) <u>Continuing Projects Initiated in FY98 under PE 0603790D:</u>			
- (U) \$750	<b>Advanced Hybrid Propulsion Technologies Cooperative Research Project</b> (Air Force Research Laboratory/Japan) - Cooperative project to develop hybrid propulsion technology for air-to-air missiles. In FY99 the project will develop the subsystem components necessary to meet the overall project requirements of increased performance and safety, as well as providing energy management capability. The subsystem components include an injector, gas generator pressurization system, flow control valve, liquid oxidizer expulsion system, oxidizer chemistry development, and oxidizer tankage.			
- (U) \$1,500	<b>Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project</b> (Human Systems Center/Japan) - Cooperative project to develop and design a modification kit that can be retrofitted to the ACES II ejection to increase the safety and survivability of aircrew members by: increasing the stability of the seat; increasing the seat/accommodation range; and adding limb restraints. ACES II ejection seat improvements include a gender free operational capability that assures equally reduced mortality rates and serious injuries for both male and female aircrew members. The successful completion of this program is intended to reduce the number of fatalities and serious injuries for all weight classes during high speed ejection's and increase anthropometric range for aircrew population requirements. Work to be accomplished in FY99 will include the purchase of the remaining seats and hardware for the upcoming tests. The design stages will be complete and the qualification program will be initiated.			
- (U) \$1,000	<b>Air Battle Management Capabilities</b> (Electronic Systems Center/United Kingdom) - Cooperative project to develop the means for a Combined Air Operations Center (CAOC) to dynamically retask airborne and ground alert assets utilizing the capabilities of emerging national/coalition systems. The project will expand the ability of the US Theater Battle Management Core Systems (TBMCS) and UK Air Command and Control System (ACCS) to accept input from and provide output to war gaming models; establish interoperability between existing and emerging air battle planning and execution systems; provide each nation with all Air Battle Management related engineering, manufacturing, and development/production computer software documentation necessary to enable development and integration; investigate technologies and techniques to facilitate the evolution and incorporation of Theater Missile Defense (TMD) command and control capabilities into force level systems; develop and implement the ability to conduct dispersed war gaming and mission rehearsal capability at both the force and unit level.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE		
4 - Demonstration and Validation		0603790F NATO Cooperative Research and Development	February 1998 NATO	
-	(U)	\$250	<p><b>Air Command, Control, Communications and Intelligence Capabilities</b> (Electronic Systems Center/NATO Consultation, Command, and Control (C3) Agency) - Cooperative project to develop a fieldable interface between the US Contingency Theater Automated Planning System (CTAPS)/TBMCs and NATO Initial CAOC Capability (ICC) and the future NATO Air Command and Control System (ACCS). This cooperative R&amp;D effort will support air campaign planning and execution for joint and combined air operations. The scope of work to be accomplished includes advanced R&amp;D into shared data environment, developing a concept of operation for the transfer of control between National and NATO C4I systems without interrupting combat operation; and the extension of a middleware/translator product needed for the successful prosecution of a combined/joint air operation.</p> <p>(U) <u>Continuing Projects Initiated in FY98 under PE 0603790F:</u></p> <p><b>Cooperative Research and Development Efforts in Imaging Spectrometer Development</b> (Arnold Engineering and Development Center/Canada) - Cooperative project to pool the spatial and spectral advances of both the US and Canada, and develop a high-resolution sensor system capable of characterizing signatures of rockets and aircraft, for drug interdiction, and identifying trace quantities of a broad spectrum of gases in the environment. In FY99 the project will develop a brass board for concept checkout and incorporate improvements into an advanced design.</p> <p><b>Effects of the Ionosphere on Communication and Surveillance Systems</b> (Air Force Research Laboratory/France) - Cooperative project to leverage complementary equatorial ionospheric sensors and data to develop techniques for reliable warning of equatorial ionosphere disturbances that disrupt communication, surveillance, and Global Positioning System (GPS) navigation. In FY99 the project will incorporate French equatorial ionosphere data from North Africa with Air Force Research Laboratory data from South America and the Mid-Atlantic sector to characterize ionospheric scintillation conditions that disrupt communications, surveillance, and navigation systems.</p> <p><b>Observations and Modeling for Space Weather</b> (Air Force Research Laboratory/Germany) - Cooperative project involving US and German satellite sensors and experiments to provide coordinated observations and modeling of solar impact on space environment to forecast the global ionosphere and satellite drag. In FY99 the project will complete the modification of models to accept solar inputs; continue improving the use of available sensor data; and start improvements in the use of the Defense Meteorological Satellite Program (DMSP) ultraviolet sensor data.</p> <p><b>Cooperative Space Measurements</b> (Air Force Research Laboratory/Germany) - Cooperative project to fly a Department of Defense developed space plasma detector aboard a German scientific spacecraft in 1999. Joint exchange and analysis of scientific data from this mission will be used to develop better descriptive and predictive models of the space environment, enhancing the reliability of space-based communications and navigation capabilities for the US and its allies. In FY99 the Air Force Research Laboratory will support final spacecraft testing, spacecraft launch, on-orbit operations, and begin plasma detector data analysis.</p>	
-	(U)	\$250		
-	(U)	\$100		
-	(U)	\$200		
-	(U)	\$75		

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4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	NATO	
- (U) \$145	<b>Project Refractive Turbulence</b> (Air Force Research Laboratory/Australia) - Cooperative project to obtain accurate, statistically significant, world wide turbulence measurements. The turbulence data base is essential to support studies that evaluate atmospheric refraction propagation effects on the design/performance of the Airborne Laser (ABL) and the Defense Airborne Reconnaissance Office's (DARO's) high-altitude Unmanned Aerial Vehicles (UAVs) communication and surveillance systems. Data acquired also has direct applicability in assessing refractive effects on performance of Airborne Warning and Control Systems (AWACS) and Joint Surveillance Target Attack Radar Systems (JSTARS). In FY99 the project will support data reduction and analyses of aircraft turbulence measurements in Korea/Japan area and Australia.		
- (U) \$100	<b>Metal Matrix Composites for Aerospace Applications</b> (Air Force Research Laboratory/United Kingdom) - Cooperative project to improve the properties and processing of silicon carbide (SiC) -reinforced Titanium (Ti) - alloy and Aluminum (Al) - alloy metal matrix composites for aerospace applications. In FY99 improved processes for matrix coatings and carbon coatings on SiC monofilaments will be specified. Material produced will be provided to the Air Force Research Laboratory for characterization and analysis.		
- (U) \$450	<b>Advanced Combustor Chamber Concepts Program</b> (Air Force Research Laboratory/France) - Cooperative project to develop and demonstrate a composite combustor structure suitable for use in advanced hypersonic weapon systems operating to Mach 8 on liquid hydrocarbon fuels. Resulting engines will be simpler, easier to cool, lower weight, and more durable than baseline metallic designs. In FY99 the project will complete sub-element panel testing; reevaluate each design approach; and initiate detailed design and fabrication of the full scale composite combustor wall panels.		
- (U) \$400	<b>Integrated Tactical Aircraft Control (ITAC) Program</b> (Air Force Research Laboratory/France) - Cooperative project to develop, integrate and demonstrate critical flight control and flight management technologies that enable cooperative flight operations of a package comprised of manned and uninhabited combat air vehicles (UCAVs). The cooperative control architecture enables management and control of an integrated strike package by the aircrews in the combat aircraft. In FY99 the project will develop core flight control algorithms, situation assessment methods, optimized flight management and health monitoring system architectures.		
- (U) \$400	<b>Anthropometric Accommodation in Crew Systems</b> (Air Force Research Laboratory/The Netherlands) - Cooperative project to establish (a) a collection of three-dimensional (3-D) anthropometric data which accurately and consistently describes the variability of men and women in both Europe and the US (b) high quality methods for accommodation and interoperability assessment of crew systems and (c) methods for combining the data base with the assessment methods to assure accommodation and interoperability is achieved in the design process. In FY99 the project will finish the United States 3-D data collection and the first half of the European and initiate the augmented reality assessment of the aircraft crewstations.		

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- (U) \$400

**Aging Aircraft Life Prediction/Extension** (Air Force Research Laboratory/Australia) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs of metallic structures, widespread fatigue damage including multiple-element damage and multiple site damage, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and sensors for structural health monitoring. In FY99 the project will complete documenting experience with widespread fatigue damage and composite patch repairs, continue developing analysis techniques for corrosion/fatigue, continue evaluating composite patch repair analysis techniques, and initiate in-service evaluation of corrosion sensor.

- (U) \$350

**Structural Integrity of Aging Aircraft** (Air Force Research Laboratory/Canada) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, widespread fatigue damage, life extension techniques for metallic structures, corrosion and its interaction with fatigue, structural dynamics with emphasis on weapon bay acoustics, and structural health monitoring with emphasis on sensor development. In FY99 the project will develop analytical models for widespread fatigue damage and corrosion/fatigue, complete evaluation of composite patch repair analysis techniques, and identify in-service dynamics problems.

- (U) \$250

**Airworthiness of Aging Aircraft** (Air Force Research Laboratory/United Kingdom) - Cooperative project to investigate the damage that can degrade an aircraft's service life, and develop the technology to ensure the structural integrity of aging aircraft with such damage present. This project will focus on composite patch repairs for metallic structures, techniques for predicting the effects of corrosion and the interaction with fatigue loads, and structural life extension techniques for metal structures, such as the fastener-hole cold expansion process. In FY99 the project will develop analysis techniques for corrosion/fatigue and continue developing analysis techniques for life enhancement and composite patch repairs.

- (U) \$11,117

Total

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## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget FY 1998 PB	9,783	13,433	11,341	
(U) Appropriated Value	10,233	11,000		
(U) Adjustments to Appropriated Value				
a. Cong Reductions	-215	-381		
b. SBIR	-235	-205		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions	-16			
(U) Adjustments to Budget Years Since FY 1998 PB			-224	
(U) Current Budget Submit/1999 PB	9,767	10,414	11,117	

## (U) Change Summary Explanation:

(U) Funding: Prior to FY97 OSD funded NATO Cooperative R&D agreements under PE 0603790D. In FY97 responsibility for funding the NATO Cooperative R&D agreements will be shared with the Services. This program element will fund Air Force ICRD&A agreements certified by the USD(A&T).

In FY97 the Air Force reallocated a total of \$842,000 for the following projects: Vista Warrior (Armstrong Laboratory/United Kingdom): \$142,000; Programmable Integrated Ordnance Suite (PIOS) (Wright Laboratory/United Kingdom): \$250,000; Free Piston Shock Tunnel/High Enthalpy Goettingen Project (Arnold Engineering and Development Center/Germany): \$100,000; Future Multiband Multiwaveform, Modular Tactical Radio (FM3TR) (Rome Laboratory/France, Germany, United Kingdom): \$100,000; Effects of the Ionosphere on Command, Control, Communications, Intelligence (C3I) Systems (Phillips Laboratory/United Kingdom): \$100,000; Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons (Wright Laboratory/Israel): \$100,000; and Single Mode Optical Fibers for Array Imaging and Environmental Sensing (Phillips Laboratory/United Kingdom): \$50,000.

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4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	NATO	
<p>The reallocation sources included:</p> <ul style="list-style-type: none"><li>- \$562,000 from Advanced Flooding Agent (Wright Laboratory/United Kingdom), since the proposed agreement was withdrawn after further review. All funding and activities dealing with Halon 1301 replacements will be addressed by DDR&amp;E's Next Generation Plan (NGP).</li><li>- \$280,000 from Cooperative Research and Development Efforts in Imaging Spectrometer Development (Arnold Engineering and Development Center/Canada), since the proposed agreement was placed on hold pending completion of a HQ USAF review. HQ USAF completed its review and rescoped the agreement. The agreement has been forwarded to Canada for negotiations and is currently scheduled to be concluded in FY98.</li></ul> <p><u>In FY98</u> the Air Force will allocate additional funding for the following projects to take advantage of favorable program and technological developments: Single Mode Optical Fibers for Array Imaging and Environmental Sensing (Air Force Research Laboratory (formerly Phillips Laboratory)/United Kingdom): \$50,000; Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons (Air Force Research Laboratory (formerly Wright Laboratory)/Israel): \$100,000; Cooperative Space Measurements (Air Force Research Laboratory (formerly Phillips Laboratory)/Germany): \$100,000; Aftbody/Nozzle Aeroacoustics Project (ANAP) (Air Force Research Laboratory (formerly Wright Laboratory)/ United Kingdom): \$50,000 (This project was initially funded in FY97 under OSD NATO Cooperative R&amp;D PE0603790D and listed in the 1997 Annual Report to Congress on International Cooperative Research and Development).</p>			

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BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
<b>4 - Demonstration and Validation</b>		<b>0603790F NATO Cooperative Research and Development</b>	<b>NATO</b>
<p>(U) Schedule: <u>Dense Metal Case Penetrating Weapon (DMCPW) (Wright Laboratory/United Kingdom)</u> - Original planning with the United Kingdom led to the development of a schedule which would culminate in a weapon demonstration in late FY98 to early FY99. Subsequent planning and coordination with the United Kingdom moved the demonstration to late FY99.</p> <p><u>Image Information Reformatter (IIR) (Rome Laboratory/France)</u> - Award of the Phase II contract for the development and evaluation of the Advanced Development Model IIR has been rescheduled due to delays in coordinating and structuring the program with the French.</p> <p><u>Cooperative Research and Development Efforts in Imaging Spectrometer Development (formerly Cooperation in Infrared Spectral Imaging for Low Observable Signatures (Arnold Engineering and Development Center/Canada)</u> - The projected signature of the agreement shifted from FY97 to FY98, since the proposal was placed on hold pending completion of a HQ USAF review. HQ USAF completed its review and rescoped the agreement. The agreement has been forwarded to Canada for negotiations.</p> <p><u>Effects of the Ionosphere on Communications and Surveillance Systems (Phillips Laboratory/France)</u> - The projected signature of the agreement shifted from FY97 to FY98 due to recent changes in how the French Ministry of Defense processes international agreements.</p> <p>(U) Technical: <u>Very High Resolution Imaging by Interferometry (Phillips Laboratory/France)</u> - The project was put on hold pending completion of an OSD review and subsequently withdrawn.</p> <p><u>Advanced Flooding Agent (Wright Laboratory/United Kingdom)</u> - The Air Force withdrew the proposal since DDR&amp;E recently approved a comprehensive Next Generation Plan (NGP) to address Halon 1301 replacements. The Air Force's Advanced Flooding Agent proposal was initiated before the NGP was developed and approved.</p> <p><u>Transatlantic Research into Air Combat Engagements (TRACE) Phase 2 (Wright Laboratory/Germany)</u> - The Air Force withdrew from the proposed Phase II effort, since the research emphasis within the Simulation Control Integration and Assessment Branch has changed from network optimization to flight control research.</p>			
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4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development	NATO								
(U) C. Other Program Funding Summary (\$ in Thousands)										
(U) N/A		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
<p>Related RDT&amp;E:</p> <p>(U) This program element complements OSD NATO Cooperative R&amp;D PE 0603790D which funds the first year only of any new DoD agreement. It also provides ICRD&amp;A funds for USAF Laboratory 6.1 through 6.3 programs and USAF Product, Test, and Logistics Center 6.4 through 6.5 programs. Management support for Air Force NATO Cooperative R&amp;D PE 0603790F is funded in Air Force International Activities PE 1001004F at the level of \$300,000 per fiscal year.</p>										
(U) D. Schedule Profile										
(U) Image/Information Reformatter (IIR)		1	2	3	4	1	2	3	4	
(U) Concept definition activities		X					X			
(U) Draft program implementation plan		X					X			
(U) Request for proposal released										
(U) Contract award										
(U) Development and fabrication of Advanced Development Model IIR and interfaces										X

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	FY 1997				FY 1998			FY 1999				
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Experimental Air Operations Center (EAOC)												X
(U) Research and advanced development into key command and control (C2) areas of Combined Air Operations Center (CAOC) functionality	X											
(U) Early fielding in Theater Battle Management Core System (TBMCS) core releases					X			X				
(U) Project demonstration				X		X		X				
(U) Vista Warrior												
(U) Develop and demonstrate advanced technologies and interface concepts in labs and simulators	X									X		
(U) Demonstrate the technology developed on operational fast jet aircraft					X							
(U) Assess advanced head/helmet tracker technologies					X			X				
(U) Demonstrate advanced head/helmet tracker									X	X		

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## 4 - Demonstration and Validation

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		FY 1997				FY 1998				FY 1999			
		1	2	3	4	1	2	3	4	1	2	3	4
(U) Effects of the Ionosphere on C3I Systems													
(U) Validate Global Positioning System-Meteorological (GPS-Met) data to drive sensor driven ionospheric models			X										
(U) Assess near real-time UK ionospheric tomography data in the US Parameterized Ionosphere-Specification Model (PRISM)					X								
(U) UK provide the latest Ray-Tracing algorithms for use with the PRISM							X						
(U) Assess UK oblique sounder system						X							
(U) Expand C3I outage alert areas to include South American and Atlantic sectors							X						
(U) Couple US PRISM model to UK Ray-Tracing Code										X			
(U) Develop algorithms to couple GPS-Met data into PRISM model											X		
(U) Expand C3I outage alert coverage to include North Africa/Middle East sector												X	
(U) Assess use of GPS-Met data for global ionosphere specification application													X
(U) Validate the use of multi-ionospheric sensor data/displays to improve the accuracy of surveillance radar range corrections													X

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## 4 - Demonstration and Validation

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## Development

	FY 1997		FY 1998		FY 1999			
	1	2	3	4	1	2	3	4
(U) Future Multiband, Multi-waveform Modular Tactical Radio (FM3TR)								
(U) Waveform definition completed	X							
(U) Waveform hosting				X				
(U) US demonstration					X			
(U) International demos						X		
(U) Single Mode (SM) Optical Fibers for Array Imaging and for Environmental Sensing								
(U) SM optical fiber signal demonstration, identification of key parameters, development of control loops	X							
(U) Evaluation of Wavefront Sensing (WFS) techniques and characterization of Multi-Core SM Fiber (MCSMF)	X			X				
(U) Test and evaluation of MCSMF					X			
(U) Construction of fiber sensor and prototype							X	
								X

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Development

	FY 1997			FY 1998			FY 1999					
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Adaptive Flexible Structures for Air Vehicle Applications												
(U) Agreement signed				X								
(U) US deliver and install buffet load alleviation (BLA) control system				X								
(U) Australia attach facility sensors				X								
(U) Australia install test aircraft in facility				X								
(U) Australia conduct open-loop test					X							
(U) US and Australia reduce and distribute open-loop data					X							
(U) Develop control algorithms					X							
(U) Australia conduct closed-loop test						X						
(U) Prepare final report							X					
(U) Dense Metal Case Penetrating Weapon (DMCPW)												
(U) Agreement signed			X									
(U) Concept definition		X	X									
(U) Preliminary design			X				X					
(U) Detailed design, development, and ground testing							X			X		
(U) Final design and flight testing									X			X
(U) US ground sled demonstration tests									X			
(U) US flight weapon demonstration tests										X		
(U) UK subscale full scale penetrator design and underground trials			X								X	
(U) System analyses and material tests			X									X

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	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Cooperative Research and Development Efforts in Imaging Spectrometer Development												
(U) Agreement signed							X					
(U) Preliminary design							X					
(U) Concept checkout									X			
(U) Interim report												
(U) Advanced design												
(U) Effects of the Ionosphere on Communications and Surveillance Systems												
(U) Agreement signed								X				
(U) US provide ionosphere model									X			
(U) Identify/exchange available US/France equatorial ionosphere data												
(U) US and France specify requirements for low power digital ionospheric sounder (LPDIS)										X		

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**4 - Demonstration and Validation**

**0603790F NATO Cooperative Research and Development**

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	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) Free Piston Shock Tunnel/High Enthalpy Goettingen Project									
(U) Agreement signed		X							
(U) Specify testing conditions, test articles, instrumentation and diagnostics		X							
(U) Calibration, fabrication of models, testing					X				
(U) Exchange consultations		X			X				
(U) Exchange instrumentation and diagnostic articles					X	X			
(U) Computational fluid dynamics code development and validation						X			
(U) Final report							X		
(U) Programmable Integrated Ordnance Suite (PIOS)									
(U) Agreement signed		X							
(U) Model and evaluate concept ordnance suites		X							
(U) Perform preliminary design of selected ordnance suite concept						X			
(U) Perform detailed engineering design of fuze and warhead								X	

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4 - Demonstration and Validation	0603790F NATO Cooperative Research and Development							NATO
	FY 1997	FY 1998	FY 1999					
	1	2	3	4	1	2	3	4
(U) Observations and Modeling for Space Weather								
(U) Agreement signed				X				
(U) Exchange existing data				X	X			
(U) Analyze existing data				X		X		
(U) Upgrade models					X			X
(U) Regional/Sector Air Operations Center (R/SAOC) Modernization Program								
(U) Request for proposal released	X							
(U) Contract award		X						
(U) Early fielding							X	
(U) Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons								
(U) Agreement signed		X						
(U) Materials evaluation and selection				X				
(U) Structural component evaluation			X					
(U) Full structure field tests					X			
(U) Data reduction/analysis/field manual						X		

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

## February 1998

PE NUMBER AND TITLE

**0603790F NATO Cooperative Research and Development**

**PROJECT  
NATO**

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) <b>Cooperative Space Measurements</b>												
(U) Preliminary design	X	X										
(U) Detailed design		X		X								
(U) Agreement signed							X					
(U) Development and test				X			X					
(U) Delivery to spacecraft integrator							X					
(U) Spacecraft integration and test							X			X		
(U) Launch												
(U) Data collection										X		
(U) <b>Project Refractive Turbulence</b>												
(U) Design tail probe support					X							
(U) Build tail probe mount						X						
(U) Install tail turbulence probe							X					
(U) Aircraft certification					X							
(U) Agreement signed						X						
(U) Test measuring systems on aircraft					X							
(U) Flight measurements						X		X		X		
(U) Field measurement reports						X			X	X		
(U) Data reduction						X				X		
(U) Data analysis						X		X				

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	FY 1997		FY 1998		FY 1999			
	1	2	3	4	1	2	3	4
(U) Metal Matrix Composites (MMCs) for Aerospace Applications								
(U) Agreement signed					X			
(U) Concept definition			X	X	X			
(U) Produce and evaluate MMCs								X
(U) Specify improved MMCs						X		X
(U) Produce and evaluate improved MMC								X
(U) Advanced Combustor Chamber Concepts Program								
(U) Agreement signed						X		X
(U) Combustor conceptual design						X		X
(U) Material/fabrication sample tests						X		
(U) Cooled panel tests							X	X
(U) Evaluate design approach								X
(U) Integrated Tactical Aircraft Control (ITAC) Program								
(U) Agreement signed					X			
(U) System definition					X			
(U) System design								
(U) Detailed design								X
								X

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4 - Demonstration and Validation		0603790F NATO Cooperative Research and Development				February 1998			
						PROJECT			
						NATO			

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0603790F NATO Cooperative Research and Development

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	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Aging Aircraft Life Prediction/Extension												
(U) Agreement Signed						X						
(U) Document widespread fatigue damage experience												
(U) Coordinate with US												
(U) Develop corrosion/fatigue analysis techniques									X			
(U) Document composite patch service experience						X						
(U) Evaluate existing composite patch analysis techniques for metallic structures						X						
(U) Identify health monitoring sensors						X						
(U) Prepare for flight tests									X			
(U) Airworthiness of Aging Aircraft												
(U) Agreement signed					X							
(U) Develop life enhancement analysis techniques										X		
(U) Conduct experiments												
(U) Document corrosion/fatigue service experience												X
(U) Document composite patch service experience						X						
(U) Evaluate existing composite patch analysis techniques for metallic structures											X	

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## 4 - Demonstration and Validation

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NATO

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) Structural Integrity of Aging Aircraft									
(U) Agreement signed					X				
(U) Document widespread fatigue damage service experience						X			
(U) Develop widespread fatigue damage analytical models									
(U) Develop corrosion/fatigue analysis techniques							X		
(U) Evaluate existing composite patch analysis techniques for metallic structures					X				
(U) Identify candidate solutions for dynamic control									
(U) Develop health monitoring brassboard models							X		
(U) Identify fatigue life enhancement techniques									
(U) Advanced Hybrid Propulsion Technologies Cooperative Research Project									
(U) Agreement signed							X		
(U) Detail design					X				
(U) Oxidizer expulsion system					X				
(U) Controls					X	X			
(U) Injector					X	X			
(U) Pressurization system					X				
(U) Oxidizer development					X				

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	FY 1997			FY 1998			FY 1999					
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Air Battle Management Capabilities												
(U) Agreement Signed						X						
(U) Draft program and implementation plan							X	X				
(U) Contract change request released								X				
(U) Issue technical task descriptive									X			
(U) Program definition/Project plan								X	X			
(U) Research and develop capabilities defined in project plan									X			
(U) Early fielding of developed capabilities into US Theater Battle Management Core System (TBMCS) and UK Air Command and Control System (ACCS)										X		
(U) Battle Lab verification and development test									X			
(U) Project demonstration											X	
(U) Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project												
(U) ACES II Preliminary design							X					
(U) Agreement signed							X					
(U) Engineering, manufacturing, development								X				
(U) Detailed design									X			
(U) Complete design											X	
(U) Qualification program												X

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4 - Demonstration and Validation		0603790F NATO Cooperative Research and Development				February 1998		NATO	
		FY 1997		FY 1998		FY 1999			
		1	2	3	4	1	2		
(U) Air Command, Control, Communications and Intelligence Capabilities									
(U) Agreement Signed									
(U) Draft program and implementation plan					X				
(U) Contract change request released									
(U) Issue technical task descriptive						X			
(U) Program definition						X			
(U) Scope work effort to achieve shared data environment							X		
(U) Develop translator extensions							X		X
(U) US/NATO Battle Lab verification and development test								X	X
(U) Examine US/NATO Concept of Operations in coalition environment in terms of shared data environment							X		X

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## (U) A. Project Cost Breakdown (\$ in Thousands)

\*Prior to FY97 OSD funded NATO Cooperative R&D agreements under PE0603790D. In FY97 responsibility for funding NATO Cooperative R&D agreements will be shared with the Services. Prior OSD cost information for Air Force projects is not shown.

Complete information regarding the use of NATO Cooperative R&D funds is not available for all proposed agreements, since some are still being negotiated or were recently signed. In addition, future funding for continuing agreements is not available in all instances because the funds are used as needed to supplement a project office's related 6.1 through 6.5 RDT&E appropriations.

	FY 1997	FY 1998	FY 1999
(U) Image Information Reformatter (IIR)	475	400	1,200
(U) Experimental Air Operations Center (EAOC)	2,700	0	0
(U) Vista Warrior	2,742	2,300	1,000
(U) Effects of the Ionosphere on Command, Control, Communications, and Intelligence (C3I) Systems	800	500	400
(U) Future Multiband, Multiwaveform Modular Tactical Radio (FM3TR)	800	0	0
(U) Single Mode Optical Fibers for Array Imaging and for Environmental Sensing	150	150	0
(U) Free Piston Shock Tunnel/High Enthalpy Goettingen Project	500	500	200
(U) Programmable Integrated Ordnance Suite (PIOS)	750	500	0
(U) Adaptive Flexible Structures for Air Vehicle Applications	200	0	0
(U) Dense Metal Case Penetrating Weapon (DMCPW)	200	1,100	1,697
(U) Strengthening of Concrete Structures for Enhanced Structural Survivability Against Conventional and Terrorist Weapons	450	550	0
(U) Airbody/Nozzle Aeroacoustics Program (ANAP)	0	50	0
(U) Regional/Sector Air Operations Center (R/SAOC) Modernization Program	0	1,150	0
(U) Cooperative Research and Development Efforts in Imaging Spectrometer Development	0	284	250
(U) Effects of the Ionosphere on Communication and Surveillance Systems	0	100	100

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	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Observations and Modeling for Space Weather	0	200	200
(U) Cooperative Space Measurements	0	200	75
(U) Project Refractive Turbulence	0	180	145
(U) Metal Matrix Composites for Aerospace Applications	0	100	100
(U) Advanced Combustor Chamber Concepts Program	0	300	450
(U) Integrated Tactical Aircraft Control (ITAC) Program	0	450	400
(U) Anthropometric Accommodation in Crew Systems	0	400	400
(U) Aging Aircraft Life Prediction/Extension	0	400	400
(U) Structural Integrity of Aging Aircraft	0	350	350
(U) Airworthiness of Aging Aircraft	0	250	250
(U) Advanced Hybrid Propulsion Technologies Cooperative Research Project	0	0	750
(U) Advanced Crew Ejection Seat (ACES) II - Ejection Seat Cooperative Modification Project	0	0	1,500
(U) Air Battle Management Capabilities	0	0	1,000
(U) Air Command, Control, Communications and Intelligence Capabilities	0	0	250
(U) Total	9,767	10,414	11,117

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BUDGET ACTIVITY										PE NUMBER AND TITLE		
4 - Demonstration and Validation										0603790F NATO Cooperative Research and Development		
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)												
Performing Organizations:												
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program		
<u>Product Development Organizations</u>												
L3	CPFF	Sep 95			101	0	0	0	0	101		
<u>Communications</u>												
Salt Lake City, UT												
TBD	CPFF	Jul 98			284	320	1,120	0	0	1,724		
Lockheed Martin	CPAF	Oct 95			1,000	0	650	TBD	TBD	TBD		
<u>Colorado Springs, CO</u>												
Logicon	CPFF	Jun 94			1,000	0	0	0	0	1,000		
San Pedro, CA												
Boeing	CPIF	May 94			1,450	650	450	0	0	2,550		
St Louis, MO												
Sytronics	CPFF	Sep 93			2	400	400	400	400	1,202		
Dayton, OH												
Logicon	CPFF	Jan 94			1,246	1,255	505	0	0	3,006		
San Pedro, CA												
Night Vision Corporation	CPFF	Jul 96			0	350	0	0	0	350		
<u>Lincolnwood, IL</u>												
Boston College	CR	Mar 97			50	75	60	TBD	TBD	TBD		
Boston, MA												
RADEX	CPFF	Mar 97			190	200	150	TBD	TBD	TBD		
Bedford, MA												
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## 4 - Demonstration and Validation

## 0603790F NATO Cooperative Research and Development

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Pacific Sierra Research	CPFF	Mar 97			60	0	0	0	TBD	TBD
Santa Monica, CA										
CPI	CPFF	Mar 97			75	65	50		TBD	TBD
Fairfax, VA										
University of Massachusetts	CR	Apr 97			60	60	50		TBD	TBD
Lowell, MA										
KEO Consultants	CPFF	Mar 97			160	75	75		TBD	TBD
Brookline, MA										
Northwest Research	CPFF	Apr 97			50	60	50		TBD	TBD
Associates										
Bellevue, WA										
University of Texas	CPFF	May 97			25	0	0		TBD	TBD
Austin, TX										
Applied Research Lab, University of Texas	CPFF	May 97			40	40	40		TBD	TBD
Austin, TX										
Rome Research Corporation	CPFF	Oct 96			600	0	0		0	600
Rome, NY										
Motorola	CPFF	Aug 96			287	500	0		0	787
Scottsdale, AZ										
Lockheed Martin Orlando, FL	CPFF	Sep 96			150	50	1180		0	1,380

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BUDGET ACTIVITY										PE NUMBER AND TITLE		
4 - Demonstration and Validation										0603790F NATO Cooperative Research and Development		
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity	Project Office	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program		
Raytheon TI Systems	CPFF	Dec 97				50	900	387	0	1,337		
Lewisville, TX												
Waterways Experiment Station (WES)	MIPR	Jul 97			175		225	0	0	400		
Vicksburg, MS												
Applied Research Associates	CPAF	Aug 97			175		225	0	0	400		
Panama City, FL												
Active Control Experts, Inc	CPFF	Sep 97			200		0	0	0	200		
Cambridge, MA												
Litton Data	CPAF	Mar 97					1,150	0	0	1,150		
Systems Division, Agoura Hills, CA												
TBD	CPFF	Jul 98					450	400	TBD	TBD		
UES, Inc	CPFF	Oct 97					100	100	0	200		
Dayton, OH												
NOAA/ATDD	MIPR	Oct 97					120	75	0	160		
Oak Ridge, TN												
Amptek, Inc	CPFF	Aug 96					200	75	0	275		
Bedford, MA												
TBD	CPFF	Aug 98					100	100	TBD	TBD		
TBD	CPFF	Aug 98					100	100	TBD	TBD		
Pratt & Whitney	CPFF	Jun 98					300	450	600	1,350		
West Palm Beach, FL												
TBD	CPFF	May 98					400	400	TBD	TBD		
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### 0603790F NATO Cooperative Research and Development

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
TBD	CPFF	May 98				350	350	350	TBD	TBD
TBD	CPFF	May 98				250	250	250	TBD	TBD
Boeing (McDonnell Douglas)	CPFF	Oct 98						284	TBD	TBD
St Louis, MO										
Boeing (McDonnell Douglas)	CPFF	Dec 96				50	50	0	0	50
St Louis, MO										
TBD	CPFF	Oct 98						750	1,250	2,000
<u>Support and Management Organizations</u>										
Air Force Research Laboratory Rome, NY						90	80	80	0	250
Air Force Research Laboratory Rome, NY	AF 616	Jan 96				80	0	0	0	80
MITRE Bedford, MA	MIPR	Jan 96				300	0	0	0	300
Air Force Research Laboratory Rome, NY	AF 616	Oct 98						350	TBD	TBD
MITRE Bedford, MA	MIPR	Oct 98						100	TBD	TBD

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Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete TBD	Total Program TBD
Electronic Systems Center, MA					320	0	0	150	TBD	TBD
Air Force Research Laboratory WPAFB, OH					44	45	45	0	0	134
Air Force Research Laboratory Hanscom AFB, MA					85	20	20	TBD	TBD	TBD
CPTS/FMAP Patrick AFB, FL	AF 185	May 95			5	5	5	TBD	TBD	TBD
Air Force Research Laboratory Rome, NY					100	0	0	0	0	100
BMDO Rockwell Power Systems, NM	MIPR CPAF				50 70	50 70	0 0	0 0	0 0	100 140
Air Force Research Laboratory Kirtland AFB, NM					30	30	0	0	0	60

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Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Air Force Research Laboratory Hanscom AFB, MA							20	30	0	85
Worcester Polytech Institute Worcester, MA	Intergovernm ental Personnel Act (IPA)	Oct 97				40	40	40	0	80
Air Force Research Laboratory (KHLS)					308	0	0	0	0	308
Eglin AFB, FL Naval Air Warfare Center, CA	MIPR	May 97			115	0	0	0	0	115
Dynetics Fort Walton, FL Air Force Research Laboratory	AFMC 277	Jun 97			40	0	0	0	0	40
Tyndall AFB, FL Air Force Research Laboratory					25	25	0	0	0	50
Eglin AFB, FL Pender Technology, TN	CR	Oct 97				60	38	0	0	98
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Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC*	Project Office EAC*	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete TBD	Total Program TBD
Air Force Research Laboratory WPAFB, OH	AF 616	Dec 98						650		
Human Systems Center Brooks AFB, TX	MIPR	Oct 98						551	TBD	TBD
<u>Test and Evaluation Organizations</u>										
Air Force Research Laboratory Rome, NY	MIPR				100	0	0	0	0	100
Air Force Development Test Center, FL	PO	Jan 98				80		80	0	160
Air Force Seek Eagle Office, FL	PO	Jan 98				10		12	0	22
Air Force Research Laboratory Tyndall AFB, FL					75	75		0	0	150
Sverdrup Technology, Inc TN	CPAF	Sep 95			353	500		200	0	1,053
Sverdrup Technology, Inc TN	CPAF	Sep 95				234		200	TBD	TBD

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4 - Demonstration and Validation		0603790F NATO Cooperative Research and Development								NATO	
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity	Project Office	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Holloman AFB, NM	PO	Oct 98	EAC*	EAC*	FY 1997	FY 1997	FY 1998	15	TBD	TBD	

\*Not applicable. NATO Cooperative R&D funds supplement as needed a project office's 6.1 through 6.5 RDT&E appropriations for initiating international cooperative R&D agreements and exploiting favorable program and technological opportunities with major allied partners.

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## Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total				Total Program
				Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	
<u>Product Development Property</u>								
None								
<u>Support and Management Property</u>								
None								
<u>Test and Evaluation Property</u>								
Fora laser system	PO	Nov 97	Jan 98	147	0	0	0	147
Subtotal Product Development				7,430	9,020	8,501	Cont	Cont
Subtotal Support and Management				1,662	495	2,109	Cont	Cont
Subtotal Test and Evaluation				675	899	507	Cont	Cont
Total Project				9,767	10,414	11,117	Cont	Cont

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BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603800F Joint Strike Fighter								2025	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2025 Joint Strike Fighter (JSF)		251,626	432,277	456,137	239,659	22,988	0	0	0	1,567,744	
Quantity of RDT&E Articles		0	0	0	4	0	0	0	0	0	
<p>(U) <b>A. Mission Description and Budget Item Justification</b></p> <p>The Joint Strike Fighter (JSF) Program will develop and field an affordable, highly common family of next generation strike fighter aircraft for the USN, USMC, USAF and allies. Current program emphasis is on facilitating the evolution of fully validated and affordable joint operational requirements, and demonstrating cost leveraging technologies and concepts to lower risk prior to entering Engineering and Manufacturing Demonstration (E&amp;MD) in FY 2001. This is a joint program with no executive service. Navy and Air Force each provide approximately equal shares of annual funding for the program effective in FY 1995. The United Kingdom (UK) is a collaborative partner in this phase of the program and several other countries also participate. The Defense Advanced Research Projects Agency (DARPA) is participating in the program through FY 1998. This program is funded under DEMONSTRATION &amp; VALIDATION because it integrates hardware for test related to specific ship or aircraft applications.</p> <p>(U) <b>Acquisition Strategy:</b> Concept Demonstration efforts commenced in November 1996 with competitive contract awards to Boeing and Lockheed Martin for Concept Demonstration Programs (CDP). These competing contractors will build and fly concept demonstrator aircraft, conduct concept unique ground demonstrations, and continue refinement of their ultimate delivered weapon system concepts. These efforts lead to a down-select currently scheduled for FY01 and E&amp;MD program start. Pratt and Whitney is providing propulsion hardware and engineering support for the Weapon System Concept Demonstration efforts.</p> <p>(U) FY 1997 (\$ in Thousands) (Breakout reflects Air Force, Navy, DARPA and UK:</p> <ul style="list-style-type: none"> <li>- (U) \$409,727 Competitively awarded contracts to Boeing and Lockheed Martin for ground and flight demonstrations and continued concept refinement for a tri-service family of aircraft that meets the Services' needs and optimizes commonality among the variants to minimize life cycles costs (LCC); awarded contract to Pratt &amp; Whitney for supporting propulsion efforts.</li> <li>- (U) \$25,000 Commenced Phase II of the Alternate Engine Program, which continued detailed design and begins hardware testing.</li> <li>- (U) \$152,784 Continued technology maturation demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, and mission systems. Commenced systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.</li> <li>- (U) \$7,612 Commenced technology maturation demonstrations and assessments in the area of prognostics and health management.</li> <li>- (U) \$9,629 Continued technology maturation demonstrations and assessments in the area of supportability and training.</li> <li>- (U) \$10,191 Continued modeling and simulation activities to support strike warfare mission area analysis.</li> <li>- (U) \$5,196 Continued requirements analysis efforts including Cost &amp; Operational Performance Trades (COPT) to facilitate the Services' joint requirements definition.</li> <li>- (U) \$13,937 Continued mission support, including program office functions; Congressionally directed OSD Force Structure Analysis.</li> </ul>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		February 1998	
<b>4 - Demonstration and Validation</b>	<b>0603800F Joint Strike Fighter</b>		<b>2025</b>	
- (U) \$2,097	Anticipated DARPA general reductions.			
- (U) \$636,173	Total			
(U) FY 1998 (\$ in Thousands): (Breakout reflects Air Force, Navy, DARPA, UK, Multi-Lateral and Canadian funding)				
- (U) \$696,154	Continue Concept Demonstration efforts by Boeing, Lockheed Martin and Pratt & Whitney for ground and flight demonstrations and continue concept refinement for a tri-service family of aircraft.			
- (U) \$29,000	Continue the Alternate Engine Program.			
- (U) \$181,298	Continue technology maturation demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, and mission systems. Continue systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.			
- (U) \$14,270	Continue technology maturation demonstrations and assessments in the area of prognostics and health management.			
- (U) \$8,859	Continue technology maturation demonstrations and assessments in the area of supportability and training.			
- (U) \$10,790	Continue modeling and simulation activities to support strike warfare mission area analysis.			
- (U) \$9,551	Continue requirements analysis efforts including COPT to facilitate the Services' joint requirements definition.			
- (U) \$15,071	Continue mission support, including program office functions.			
- (U) \$17,128	Anticipated Services' general reductions.			
- (U) \$982,121	Total			
(U) FY 1999 (\$ in Thousands): (Breakout reflects Air Force, Navy, DARPA, UK, Multi-Lateral and Canadian funding)				
- (U) \$702,484	Continue Concept Demonstration efforts by Boeing, Lockheed Martin and Pratt & Whitney for ground and flight demonstrations and continued concept refinement for a tri-service family of aircraft.			
- (U) \$23,000	Continue the Alternate Engine Program.			
- (U) \$184,995	Continue technology maturation demonstrations and assessments in the areas of airframe, flight systems, manufacturing and producibility, propulsion, and mission systems. Continue systems engineering support for the Concept Demonstration Phase in the areas of system test, air vehicle analysis and integration, advanced cost estimating, survivability, integrated flight and propulsion control and carrier suitability.			
- (U) \$12,467	Continue technology maturation demonstrations and assessments in the area of prognostics and health management.			
- (U) \$15,168	Continue technology maturation demonstrations and assessments in the area of supportability and training.			
- (U) \$7,591	Continue modeling and simulation activities to support strike warfare mission area analysis.			
- (U) \$6,984	Continue requirements analysis efforts including COPT to facilitate the Services' joint requirements definition; receive Joint Operational Requirements Document (JORD) from the Services.			
- (U) \$11,450	Continue mission support, including program office functions.			
- (U) \$964,139	Total			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

BUDGET ACTIVITY		DATE	PROJECT
4 - Demonstration and Validation		February 1998	2025
(U) B. Program Change Summary (\$ in Thousands)			
		PE NUMBER AND TITLE	
		0603800F Joint Strike Fighter	
		FY 1997	FY 1998
(U) Previous President's Budget (FY 1998 PB)		252,043	458,052
(U) Appropriated Value		263,836	458,052
(U) Adjustments to Appropriated Value			
a. Cong Reductions		-5,541	-15,068
b. SBIR		-6,252	-10,689
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming			
e. Rescissions		-417	
(U) Adjustments to Budget Years Since FY 1998 PB			
(U) Current Budget Submit/FY1999 President's Budget		251,626	432,277
			-9,474
			456,137
			1,567,744
(U) Change Summary Explanation:			
Funding:			
- FY 1997: Net decrease of \$12,210 reflects \$5,541 in general congressional reductions (FY 97 Appropriations Act Section 8136 (\$5,279), Section 8138 (\$246); FFRDC (\$7) and non-FFRDC (\$9)); \$6,252 in SBIR; and a rescission of \$417 for Bosnia supplemental.			
- FY 1998: Net decrease of \$25,775 reflects \$15,068 in general congressional reductions (FY98 Appropriations Act Section 8043 (\$6,854), Section 8048 (\$5,716), Section 8035 (\$20), Section 8041 (\$102) and economic assumptions (\$2,493); and \$10,689 in SBIR/STRR.			
- FY 1999: Net decrease of \$9,474 reflects inflation adjustment (\$9,174) and Service adjustment (\$300).			
Schedule:	Not Applicable		
Technical:	Not Applicable		
Total Cost			1,609,843

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY					PE NUMBER AND TITLE					PROJECT	
4 - Demonstration and Validation					0603800F Joint Strike Fighter					2025	
(U) C.a. Other Program Funding Summary (\$ in Thousands): This is a joint program with no executive service. The United Kingdom is a full collaborative partner in this phase of the program and several other countries also participate.											
(U) RDT&E	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total		
0603800N	243,286	449,674	463,402	244,983	26,158	0	0	Compl	Cost		
(U) RDT&E	70,261	22,970	0	0	0	0	0	0	1,635,724		
0603800E											
(U) United Kingdom	71,000	55,000	34,000	26,000	0	0	0	0	200,000		
(U) Multi-Lateral*	0	17,900	7,600	5,000	1,700	0	0	0	122,148		
(U) Canada	0	4,300	3,000	2,700	600	0	0	0	32,200		
									10,600		
* Netherlands, Norway and Denmark											
(U) C.b. Related Program Funding Summary (\$ in Thousands): Milestone II for E&MD of the Joint Strike Fighter (JSF) is planned in FY 2001.											
(U) RDT&E	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total		
0604800F	0	0	0	0	546,801	1,360,213	1,854,387	Compl	Cost		
(U) RDT&E								TBD*	TBD*		
0604800N											
* TBD pending completion of December 1997 Selected Acquisition Report (SAR).											
BUDGET ACTIVITY					PE NUMBER AND TITLE					PROJECT	
4 - Demonstration and Validation					0603800F Joint Strike Fighter					2025	
(U) C.a. Other Program Funding Summary (\$ in Thousands): This is a joint program with no executive service. The United Kingdom is a full collaborative partner in this phase of the program and several other countries also participate.											
(U) RDT&E	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total		
0603800N	243,286	449,674	463,402	244,983	26,158	0	0	Compl	Cost		
(U) RDT&E	70,261	22,970	0	0	0	0	0	0	1,635,724		
0603800E											
(U) United Kingdom	71,000	55,000	34,000	26,000	0	0	0	0	200,000		
(U) Multi-Lateral*	0	17,900	7,600	5,000	1,700	0	0	0	122,148		
(U) Canada	0	4,300	3,000	2,700	600	0	0	0	32,200		
									10,600		
* Netherlands, Norway and Denmark											
(U) C.b. Related Program Funding Summary (\$ in Thousands): Milestone II for E&MD of the Joint Strike Fighter (JSF) is planned in FY 2001.											
(U) RDT&E	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total		
0604800F	0	0	0	0	546,801	1,360,213	1,854,387	Compl	Cost		
(U) RDT&E								TBD*	TBD*		
0604800N											
* TBD pending completion of December 1997 Selected Acquisition Report (SAR).											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE				PROJECT	
4 - Demonstration and Validation		0603800F Joint Strike Fighter				2025	
(U) D. <u>Schedule Profile</u>							
(U) Competitively awarded Concept Demonstration Contracts to Boeing and Lockheed Martin -- Nov 1996	1	FY 1997		FY 1998		FY 1999	
	X	2	3	4	1	2	3
(U) Initial Design Review -- Sep 1997							
(U) JIRD III approval -- Oct 1999							

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603800F Joint Strike Fighter

2025

(U) A. Project Cost Breakdown (\$ in Thousands)

## Project Cost Categories:

FY 1997 FY 1998 FY 1999

(U) a. Weapon System Concept Demonstrations Contracts  
(including flying demonstrations)

409,727 696,154 702,484

(U) b. Alternate Engine Program

25,000 29,000 23,000

(U) c. Technology Maturation and Systems Engineering  
Support Total

152,784 181,298 184,995

## Breakout:

Technology Maturation

Airframe

8,370 1,509 1,200

Flight Systems

38,445 29,912 26,790

Manufacturing &amp; Producibility

6,577 4,610 5,134

Propulsion

23,605 32,159 6,319

Mission Systems

37,025 59,558 99,050

Subtotal - Technology Maturation

114,022 127,748 138,493

Plus: Systems Engineering Support

38,762 53,550 46,502

(U) d. Prognostics and Health Management

7,612 14,270 12,467

(U) e. Supportability and Training

9,629 8,859 15,168

(U) f. Requirements Total:

15,387 20,341 14,575

## Breakout:

Modeling and Simulation

10,191 10,790 7,591

Analysis, Threat/Intelligence, Cost &amp;

5,196 9,551 6,984

Operational Performance Trades and

Core Team Support

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE	February 1998	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		0603800F Joint Strike Fighter		
4 - Demonstration and Validation	FY 1997	FY 1998	FY 1999	2025	
Project Cost Categories:					
(U) g. Mission Support	13,937	15,071	11,450		
(U) h. Services' General Reductions	2,097	17,128	0		
(U) Total	636,173	982,566	964,139		
Funding Resources:					
0603800F	251,626	432,277	456,137		
0603800N	243,286	449,674	463,402		
0603800E	70,261	22,970	0		
United Kingdom	71,000	55,000	34,000		
Multi-Lateral	0	17,900	7,600		
Canada	0	4,300	3,000		
(U) Total	636,173	982,121	964,139		

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
2025

## 4 - Demonstration and Validation

0603800F Joint Strike Fighter

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands) No budget in FY 1993 and Prior.

## Performing Organizations:

Contractor or Government  
Performing Activity

Method/  
Type or  
Funding  
Vehicle

Award or  
Obligation  
Date

Performing  
Activity  
EAC

Project  
Office  
EAC

Total  
Prior to  
FY 1997

FY 1997

FY 1998

Budget  
FY 1999

Budget to  
Complete

Total  
Program

## Product Development:

## Strike Warfare Concept Studies (Total Prior to FY 1997)

Miscellaneous Various 11,467 11,467 11,467

Oct93 - Sep94

11,467

## Technology Maturation Concept Exploration Phase (Total Prior to FY 1997)

Fld. Act. Various 3,432 3,432 3,432

Oct93 - Sep94

3,432

## Strike Warfare Systems Design Development (Total Prior to FY 1997)

Boeing C/CPFF Dec 94 32,770 32,770 32,770

Seattle WA

McAir C/CPFF Dec 94 23,708 23,708 23,708

St. Louis MO

Northrop C/CPFF Dec 94 21,358 21,358 21,358

Pico Rivera CA

Lockheed C/CPFF Dec 94 28,311 28,311 28,311

Fort Worth, TX

Miscellaneous Various 1,121 1,121 1,121

Fld. Act. Various Oct95- Sep96 8,322 8,322 8,322

115,590 115,590 115,590

SUBTOTAL

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	PROJECT
BUDGET ACTIVITY										February 1998	2025
4 - Demonstration and Validation										PE NUMBER AND TITLE	
Contractor or Government Contract										0603800F Joint Strike Fighter	
Performing Activity	Method/ Type or Funding	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>ASTOVL (Total Prior to FY 1997)</u>											
Lockheed	SS/CPFF	Oct 94	16,416	16,416	16,416						16,416
Boeing	SS/CPFF	Jan 95	11,200	11,200	11,200						11,200
Miscellaneous	Various	Various	15,539	15,539	15,539						15,539
SUBTOTAL			43,155	43,155	43,155						43,155
<u>Core Team Support (Total Prior to FY 1997)</u>											
Fld. Activ.	Various	Oct 96- Sep 97	2,522	2,522	2,522						2,522
<u>Weapon System Concept Demonstrations (including flying demonstrators and supporting propulsion efforts)</u>											
Boeing	C/CPFF	Nov 96	649,802	649,802	72,208			182,827	238,684	156,083	649,802
Lockheed	C/CPFF	Nov 96	706,800	706,800	105,900			203,200	246,900	150,800	706,800
Pratt & Whitney	SS/CPAF	Nov 96	832,046	832,046	231,619			310,127	216,900	73,400	832,046
West Palm Beach FL											
SUBTOTAL			2,188,648	2,188,648	409,727			696,154	702,484	380,283	2,188,648
*includes government managed equipment											
<u>Alternative Engine Program</u>											
GE	SS/CPFF	Nov 95	114,000	114,000	7,000			29,000	23,000	30,000	114,000
<u>Technology Maturation</u>											
<u>Airframe</u>											
McAir	SS/CPFF	Dec 94	19,240	19,240	12,100			7,140			19,240
Miscellaneous	Various	Various	2,485	2,485	1,861			24	500		2,485
Fld. Activ.	Various	Oct98- Sep99	5,603	5,603	1,788			1,106	700	600	5,603
SUBTOTAL			27,328	27,328	15,749			8,270	1,200	600	27,328
<u>Flight Systems</u>											
Lockheed	C/CPFF	Dec 94	51,227	51,227	15,296			16,088	7,708	2,106	51,227
Project 2025											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	PROJECT
BUDGET ACTIVITY										February 1998	2025
4 - Demonstration and Validation										PE NUMBER AND TITLE	
Contractor or Government Contract										0603800F Joint Strike Fighter	
Performing Activity	Method/ Type or Funding	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program	
McAir	C/CPFF	Dec 94	65,426	65,426	14,701	16,900	15,200	13,400	5,225	65,426	
Miscellaneous	Various	Various	9,801	9,801	6,898	1,535	657	400	311	9,801	
Fld. Activ.	Various	Oct98- Sep99	19,568	19,568	5,926	3,872	3,938	5,162	670	19,568	
SUBTOTAL			146,022	146,022	42,821	38,395	29,824	26,670	8,312	146,022	
<u>Manufacturing &amp; Producibility</u>											
Hughes	C/CPFF	Dec 94	5,065	5,065	3,035	2,030				5,065	
Los Angeles CA											
Lockheed	C/CPFF	Dec 94	11,190	11,190	2,897	1,836	2,767	2,890	800	11,190	
General Res. Corp.	C/CPFF	Dec 94	1,945	1,945	1,945					1,945	
Huntsville AL											
Scaled Comp	C/CPFF	Jun 97	2,000	2,000		2,000				2,000	
Miscellaneous	Various	Various	3,138	3,138	830	178	1,035	1,095		3,138	
Fld. Activ.	Various	Oct98- Sep99	5,915	5,915	1,925	533	808	1,149	1,500	5,915	
SUBTOTAL			29,253	29,253	10,632	6,577	4,610	5,134	2,300	29,253	
<u>Propulsion</u>											
Pratt/Whitney	C/CPFF	Dec 94	5,448	5,448	5,448					5,448	
GE	SS/CPFF	Dec 94	5,681	5,681	5,681					5,681	
Cincinnati OH											
Pratt/Whitney	SS/CPFF	Nov 95	30,000	30,000	30,000					30,000	
Pratt/Whitney	SS/CPFF	Feb 97	29,787	29,787		13,859	13,009	2,919		29,787	
Pratt/Whitney	SS/CPFF	Mar 97	3,640	3,640		3,640				3,640	
Pratt/Whitney	SS/TBD	Dec 97	9,200	9,200		2,400	5,600	1,200		9,200	
Miscellaneous	Various	Various	12,895	12,895	12,895					12,895	
Fld. Activ.	Various	Oct98- Sep99	21,670	21,670	2,214	3,706	13,550	2,200	0	21,670	
SUBTOTAL			118,321	118,321	56,238	23,605	32,159	6,319	0	118,321	
Project 2025											
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT
BUDGET ACTIVITY										PE NUMBER AND TITLE		
4 - Demonstration and Validation										0603800F Joint Strike Fighter		
Contractor or Government Contract										Total		
Performing Activity	Method/ Type or Funding	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1997	FY 1998	FY 1999	Budget Complete	Budget to Complete	Total Program
<u>Mission Systems</u>												
TI	C/CPFF	Dec 94	2,464	2,464	2,464							2,464
Plano TX												
Lockheed	SS/CPFF	Dec 95	6,856	6,856	3,006	2,250	1,600					6,856
McAir	SS/CPFF	Dec 95	6,524	6,524	2,674	2,250	1,600					6,524
Hughes	C/CPFF	Dec 95	54,637	54,637	5,153	8,619	13,502		23,832	3,531		54,637
Westinghouse	C/CPFF	Dec 95	49,998	49,998	4,788	7,660	13,498		20,522	3,530		49,998
Baltimore MD												
Boeing	C/CPFF	Mar 96	33,024	33,024	300	3,874	11,000		16,700	1,150		33,024
Lockheed	C/CPFF	Mar 96	32,993	32,993	300	3,843	11,000		16,700	1,150		32,993
New Contract	C/CPFF	Jan 98	19,599	19,599			2,200		5,000	12,399		19,599
New Contract	C/CPFF	Dec 98	12,800	12,800					8,400	4,400		12,800
New Contract	C/CPFF	Dec 98	5,300	5,300					1,000	4,300		5,300
Hughes	C/CPFF	Dec 94	3,681	3,681	2,628	1,053						3,681
Miscellaneous	Various	Various	20,097	20,097	18,853	930	314		6,596	4,870		20,097
Fld. Activ.	Various	Oct98- Sep99	33,551	33,551	10,982	6,546	4,557					33,551
SUBTOTAL			281,524	281,524	51,148	37,025	59,271		98,750	35,330		281,524
<u>Systems Engineering Spt</u>												
Miscellaneous	Various	Various	16,423	16,423		4,780	4,923		3,020	3,700		16,423
Fld. Activ.	Various	Oct98- Sep99	173,205	173,205		33,578	48,177		42,982	48,468		173,205
SUBTOTAL			189,628	189,628		38,358	53,100		46,002	52,168		189,628
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY										PROJECT	
4 - Demonstration and Validation										2025	
Contractor or Government										PE NUMBER AND TITLE	
Contract										0603800F Joint Strike Fighter	
Performing Activity										Total	
Method/										FY 1997	
Type or										FY 1997	
Funding										FY 1998	
Vehicle										FY 1999	
Award or										Budget	
Obligation										Complete	
Date										Budget to	
EAC										Total	
EAC										Program	
Prognostics and Health										Total	
Management										Total	
Boeing	C/CPFF	Jun 97	11,100	11,100	750	3,700	3,750	2,900	11,100		
Lockheed	C/CPFF	Apr 97	13,100	13,100	2,050	3,000	5,350	2,700	13,100		
Pratt/Whitney	C/CPFF	Jun 97	10,100	10,100	3,920	6,180	0	0	10,100		
General Electric	C/CPFF	Mar 98	3,067	3,067	0	200	2,617	250	3,067		
Miscellaneous	Various	Various	2,099	2,099	559	990	550	0	2,099		
Fld. Activ.	Various	Oct98-Sep99	933	933	333	200	200	200	933		
SUBTOTAL			40,399	40,399	7,612	14,270	12,467	6,050	40,399		
Supportability and Training										Total	
Classified										Total	
Project 3	C/CPFF	Dec 94	13,037	13,037	2,262	3,250	1,675	2,850	13,037		
Project 4	C/CPFF	Dec 94	9,324	9,324	1,038	1,236	1,675	2,850	9,324		
Boeing	C/CPFF	Jun 97	3,875	3,875	1,000	1,375	1,500	3,875	3,875		
Lockheed	C/CPFF	Jun 97	3,875	3,875	1,000	1,375	1,500	3,875	3,875		
New Contract	C/CPFF	Jan 99	28,141	28,141			7,618	20,523	28,141		
Miscellaneous	Various	Various	2,271	2,271	2,127	144			2,271		
Fld. Activ.	Various	Oct98-Sep99	10,317	10,317	3,044	1,598	1,170	2,565	10,317		
SUBTOTAL			70,840	70,840	8,471	8,834	15,138	28,788	70,840		
Modeling and Simulation										Total	
Miscellaneous	Various	Various	32,576	32,576	4,341	9,137	6,269	6,288	32,576		
Fld. Activ.	Various	Oct98-Sep99	9,114	9,114	1,807	1,403	1,072	1,672	9,114		
SUBTOTAL			41,690	41,690	6,148	10,540	7,341	7,960	41,690		
Project 2025										Exhibit R-3 (PE 0603800F)	

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	PROJECT
BUDGET ACTIVITY											2025
4 - Demonstration and Validation										0603800F Joint Strike Fighter	
Contractor or Government Contract										PE NUMBER AND TITLE	
Performing Activity	Method/ Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Analysis, Threat, COPT and Core Support											
Miscellaneous	Various	Various	25,104	25,104	7,298	3,918	6,551	4,620	2,717	25,104	
Fld. Activ.	Various	Oct98-Sep99	16,949	16,949	8,794	1,048	2,770	2,114	2,223	16,949	
SUBTOTAL			42,053	42,053	16,092	4,966	9,321	6,734	4,940	42,053	
Mission Support											
Institute for Defense Anal	Grant	Jan 97	2,500	2,500	0	2,500	0	0	0	2,500	
Fld. Activ.	Various	Oct98-Sep99	29,059	29,059	7,896	4,429	7,016	4,578	5,140	29,059	
SUBTOTAL			32,004	32,004	7,896	6,929	7,016	4,578	5,140	31,559	
Support and Management Organizations (CS):											
ANSER	SS/CPFF	Apr 94	19,042	19,042	9,793	5,028	4,221			19,042	
Arlington VA											
New Contract	C/CPFF	Feb 00	6,952	6,952	0	0	0	3,721	3,231	6,952	
Miscellaneous	Various	Various	25,766	25,766	8,041	3,274	5,164	4,601	4,686	25,766	
SUBTOTAL			51,760	51,760	17,834	8,302	9,385	8,322	7,917	51,760	
Test and Evaluation Organizations: (Included Above)											
Government Furnished Property: N/A											
Subtotal Product Development											
Subtotal Support and Management											
Services' General Reductions											
Total											
Prior to											
FY 1997											
398,361											
FY 1997											
625,774											
FY 1998											
955,608											
Budget											
FY 1999											
955,817											
Budget to											
Complete											
561,871											
Total											
Program											
3,497,431											
Subtotal Product Development											
Subtotal Support and Management											
Services' General Reductions											
0											
2,097											
17,128											
0											
0											
19,225											
Exhibit R-3 (PE 0603800F)											
Page 13 of 14 Pages											
Project 2025											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE				
4 - Demonstration and Validation		0603800F Joint Strike Fighter		2025		
Subtotal Test and Evaluation Subtotal Test and Evaluation		0	0	0	0	0
Total Project		416,195	636,173	982,121	964,139	3,568,416

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
4 - Demonstration and Validation		0603851F ICBM Dem/Val									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		45,961	46,372	29,360	34,149	47,487	45,519	49,121	Continuing	Continuing	
1020 ICBM Guidance Applications		15,775	16,061	13,278	15,345	21,619	18,722	20,862	Continuing	Continuing	
1021 ICBM Propulsion Applications		183	181	185	184	181	1,714	1,696	Continuing	Continuing	
1022 ICBM Reentry Vehicle Applications		9,639	12,444	13,382	16,173	23,153	22,163	23,672	Continuing	Continuing	
1023 Rocket System Launch Program (RSLP) Applications		17,220	15,202	31	33	35	33	34	Continuing	Continuing	
1024 ICBM Command & Control (C2) Applications		1,051	181	185	184	181	451	447	Continuing	Continuing	
4209 Long Range Planning (LRP)		2,093	2,303	2,299	2,230	2,318	2,436	2,410	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

(U) Efforts identify methods to reduce life cycle costs, improve nuclear safety and surety, support international arms control agreements and disengagement strategies, and ensure continued ICBM viability. Program includes demonstration and validation projects for ICBM guidance options, to support reentry vehicles beyond original design life, to provide an assessment of current and future ICBM propulsion systems, and develop enhancements to ensure command and control capabilities.

(U) This program is in Budget Activity 4 - Demonstration and Validation because the projects are demonstrating the general military utility and/or cost reduction potential of advanced technologies.

**(U) Acquisition Strategy:**

(U) The ICBM System Program Office (SPO) awarded a Prime Integration Contract (PIC) to TRW on 22 Dec 97. It is anticipated all future engineering services, modification, and replacement programs will be accomplished under this contract.

(U) Studies and analyses as well as limited engineering and pre-prototype hardware development may be accomplished. All future efforts will be conducted under the ICBM PIC unless other strategies are deemed more appropriate.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE			
4 - Demonstration and Validation		0603851F ICBM Dem/Val			
(U) B. <u>Program Change Summary (\$ in Thousands)</u>					
(U) Previous President's Budget (FY 1998 PB)		FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Appropriated Value		46,037	32,837	31,951	
(U) Adjustments to Appropriated Value		48,344	49,337		
a. Cong Gen Reductions		-1,062	-1,805		
b. SBIR		-1,245	-1,160		
c. Omnibus or Other Above Threshold Reprogram					
d. Below Threshold Reprogramming					
e. Rescissions		-76			
(U) Adjustments to Budget Years Since FY 1998 PB				-2591	
(U) Current Budget Submit/FY 1999 President's Budget		45,961	46,372	29,360	Continuing
(U) Change Summary Explanation: See individual projects.					
(U) C. <u>Other Program Funding Summary (\$ in Thousands):</u> None.					
(U) D. <u>Schedule Profile:</u> See individual projects.					

Exhibit R-2 (PE 0603851F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603851F ICBM Dem/Val

1020

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1020 ICBM Guidance Applications	15,775	16,061	13,278	15,345	21,619	18,722	20,862	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification

(U) ICBM Guidance Application efforts implement the JROC-validated Mission Need Statement for Future Guidance Systems for Intercontinental Ballistic Missiles. The program focuses on disengagement strategies, significantly reducing guidance system life cycle cost, increasing nuclear surety, and evaluating/demonstrating the guidance instrument options that will keep ICBMs viable. This program also implements the Nuclear Posture Review recommendations to preserve guidance instrument technologies. The guidance applications project will demonstrate the utility and/or cost reduction potential of technologies applied to ICBM guidance systems, including future requirements.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,300 Developed Gyro Stabilized Platform acquisition documents.
- (U) \$1,311 Continued integration assessment of advanced inertial measurement unit (IMU) design into Minuteman weapon system.
- (U) \$8,379 Began advanced IMU concept prototype sled testing and evaluation.
- (U) \$3,280 Conducted advanced instrument prototype integration tests.
- (U) \$1,505 Continued radiation hardened parts design options study and implementation of results.
- (U) \$15,775 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$290 Continue development of Gyro Stabilized Platform acquisition documentation.
- (U) \$7,695 Continue integration assessment of advanced inertial measurement unit (IMU) design into Minuteman weapon system.
- (U) \$2,858 Continue advanced IMU concept prototype sled test and evaluate results.
- (U) \$2,918 Continue advanced instrument prototype integration tests.
- (U) \$2,300 Continue radiation hardened parts efforts.
- (U) \$16,061 Total

Project 1020

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
4 - Demonstration and Validation		1020	
PE NUMBER AND TITLE		0603851F ICBM Dem/Val	
(U) FY 1999 (\$ in Thousands):			
- (U) \$3,050	Continue integration studies of advanced systems concepts into Minuteman weapon system.		
- (U) \$7,228	Conduct design, test, and integration of advanced instruments.		
- (U) \$3,000	Continue radiation hardened parts efforts.		
- (U) \$13,278	Total		
(U) B. Program Change Summary (\$ in Thousands)			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 1998 PB)			Total
(U) Appropriated Value	15,233	16,834	14,545
(U) Adjustments to Appropriated Value	15,998	16,834	Continuing
a. Cong Gen Reductions	-363	-576	
b. SBIR	-402	-197	
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming			
e. Rescissions			
f. Other	542		
(U) Adjustments to Budget Years Since FY 1998 PB			-1,267
(U) Current Budget Submit/FY 1999 President's Budget	15,775	16,061	13,278
(U) Change Summary Explanation:			Continuing
Funding: FY99 includes offset reduction to fund other AF and DoD priorities. FY97 funding adjustment reflects \$542 transferred from Rocket Systems Launch Program Applications (BPAC 1023, this PE) to pay for congressional reductions erroneously assessed against this BPAC.			
Schedule: Selected FY99 studies/analyses, such as advanced IMU assessment, will be deferred until FY01.			
Technical: No significant impact.			
(U) C. Other Program Funding Summary (\$ in Thousands): None.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998	PROJECT	1020		
BUDGET ACTIVITY		PE NUMBER AND TITLE							
4 - Demonstration and Validation		0603851F ICBM Dem/Val							
(U) D. <u>Schedule Profile</u>									
		FY 1997		FY 1998		FY 1999			
		1	2	3	4	1	2	3	4
(U) Complete Gyro Stabilized Platform									
Phase 0 Activities									
(U) Complete Advanced IMU Integration									
Assessments									
(U) Complete Alternate IMU Prototype									
Development/Integration									
(U) Continue Advanced Instrument									
Technology Prototyping									
(U) Continue Radiation Hardened Parts									
Analysis									
* Started and/or Completed									

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	PROJECT
BUDGET ACTIVITY					
4 - Demonstration and Validation				PE NUMBER AND TITLE	1020
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>					
				FY 1997	FY 1998
(U) Program Management Support				285	290
(U) Contract Systems Engineering				15,490	12,988
(U) Total				15,775	13,278
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>					
Performing Organizations:					
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997
					FY 1997
					FY 1998
					FY 1999
					Budget to Complete
					Total Program
Product Development Organizations					
TRW (Prime)	C/CPAF	Dec 97	Continuing	Continuing	Continuing
Litton	C/CPAF	Aug 91	18,500	7,165	0
Lockheed-Martin	C/CPAF	Aug 91	4,200	4,136	18,419
Draper Labs	C/CPAF/FFP	Nov 91	8,100	2,065	4,136
				1,801	8,031
Support and Management Organizations					
TRW	SS/CPAF	Oct 95	1,611	1,297	79
Other Engineering Support	Various	Various	Continuing	3,355	562
				290	Continuing
					Continuing
Test and Evaluation Organizations					
Phillips Lab	MIPR	Annual	Continuing	0	2,300
Central Inertial Guidance Test Facility	PO	Annual	1,359	790	69
Navy SSP	MIPR	Aug 97	977	0	750
Wright Labs	MIPR	Jan 97	262	0	0
				227	0
				62	0
					977
					262
Project 1020				Exhibit R-3 (PE 0603851F)	

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE	February 1998	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT		
4 - Demonstration and Validation	0603851F ICBM Dem/Val		1020		
Government Furnished Property: None					
	Total				
	Prior to	Budget		Budget to	Total
	FY 1997	FY 1997	FY 1998	FY 1999	Complete
					Program
Subtotal Product Development	15,484	11,330	12,301	11,955	Continuing
Subtotal Support and Management	6,464	3,590	641	290	Continuing
Subtotal Test and Evaluation	790	855	3,119	1,033	Continuing
Total Project	22,738	15,775	16,061	13,278	Continuing

Project 1020

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603851F ICBM Dem/Val								1021	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
1021	ICBM Propulsion Applications	183	181	185	184	181	1,714	1,696	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification</u></p> <p>(U) This applications project explores alternatives and improvements to the current ICBM propulsion systems capability and studies to assess future ICBM missile propulsion requirements. Fired Propulsion System Rocket Engine (PSRE) component reuse studies will also be accomplished.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <p>- (U) \$183 Continued fired PSRE reuse study on components such as relief valves. (Only task.)</p> <p>- (U) \$183 Total</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <p>- (U) \$181 Conduct All Ordnance Destruct System capability study. (Only task.)</p> <p>- (U) \$181 Total</p> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <p>- (U) \$185 Conduct propulsion cost and performance studies for Ballistic Missile Replacement design concepts. (Only task.)</p> <p>- (U) \$185 Total</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>4 - Demonstration and Validation</b>	<b>0603851F ICBM Dem/Val</b>	<b>February 1998</b> <b>1021</b>	
<b>(U) B. <u>Program Change Summary (\$ in Thousands)</u></b>			
		<u>FY 1997</u>	<u>FY 1998</u> <u>FY 1999</u> <u>Total Cost</u>
(U) Previous President's Budget (FY 1998 PB)		183	192    189    Continuing
(U) Appropriated Value		191	192
(U) Adjustments to Appropriated Value			
a. Cong Gen Reductions		-4	-6
b. SBIR		-4	-5
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming			
e. Rescissions			
(U) Adjustments to Budget Years Since FY 1998 PB			-4
(U) Current Budget Submit/FY 1999 President's Budget		183	181    185    Continuing
(U) Change Summary Explanation:			
Funding: No significant changes.			
Schedule: No significant impact.			
Technical: No significant impact.			
<b>(U) C. <u>Other Program Funding Summary (\$ in Thousands):</u> None.</b>			
<b>(U) D. <u>Schedule Profile</u></b>			
		<u>FY 1997</u>	<u>FY 1998</u> <u>FY 1999</u>
	1    2    3	4    1    2    3    4	2    3    4
(U) Complete PSRE Reuse Studies		X*	
(U) Start/Complete Ordnance Studies			
(U) Start/Complete Cost/Perf Studies		X	X
* Started and/or Completed			X

Project 1021

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

0603851F ICBM Dem/Val

1021

## (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Contract Engineering Support	169	172	177
(U) Program Management Support	14	9	8
(U) Total	183	181	185

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
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### Product Development Organizations

TRW (Prime)	C/CPAF	Dec 97	Continuing	Continuing	361	169	172	177	Continuing	Continuing
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### Support and Management Organizations

Various	Various	Ongoing	Continuing	Continuing	35	14	9	8	Continuing	Continuing
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### Test and Evaluation Organizations

None

### Government Furnished Property: None

	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Subtotal Product Development	361	169	172	177	Continuing	Continuing
Subtotal Support and Management	35	14	9	8	Continuing	Continuing
Subtotal Test and Evaluation						
Total Project	396	183	181	185	Continuing	Continuing

Project 1021

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Exhibit R-3 (PE 0603851F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998																								
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT																									
4 - Demonstration and Validation		0603851F ICBM Dem/Val								1022																									
			FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost																								
	COST (\$ In Thousands)																																		
1022	ICBM Reentry Vehicle Applications		9,639	12,444	13,382	16,173	23,153	22,163	23,672	Continuing	Continuing																								
<p>(U) A. <u>Mission Description and Budget Item Justification</u></p> <p>(U) ICBM Reentry Vehicle (RV) Applications efforts are required to support a Minuteman force of 500 missiles, arms control treaties/initiatives directing the Minuteman force be downloaded to a single RV configuration, the need to ensure Minuteman force contains the safest, most reliable RV, and CINCSTRATCOM guidance that we should continue to ensure the continuing readiness for our strategic deterrent. ICBM RV Applications efforts will support RV's beyond their original design life through addressing problems with operational reentry systems, meeting real on-going needs, and ensuring the availability of long-lead components/materials. This project will develop methods to better predict aging phenomena, and identify life cycle cost reduction methods. Additionally, these efforts will maintain a minimum level of technical engineers and capability to respond to aging phenomena and future requirements including transition to force applications to comply with evolving Air Force global engagement strategy/vision. RV work conducted under this program will leverage the Science &amp; Technology community and coordinate with Navy RV efforts to eliminate duplication and realize synergistic cost savings.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <table border="0"> <tr> <td>-</td> <td>(U) \$2,624</td> <td>Continued to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.</td> </tr> <tr> <td>-</td> <td>(U) \$1,385</td> <td>Designed, developed, and conducted prototype testing of selected aging prediction techniques and tools.</td> </tr> <tr> <td>-</td> <td>(U) \$1,781</td> <td>Designed, developed, and conducted prototype testing of selected fuze assessment/measurement methodologies.</td> </tr> <tr> <td>-</td> <td>(U) \$1,583</td> <td>Designed, developed, and conducted prototype testing of selected sensors/instruments.</td> </tr> <tr> <td>-</td> <td>(U) \$480</td> <td>Identified and ground tested potential replacement options for critical RV components.</td> </tr> <tr> <td>-</td> <td>(U) \$1,286</td> <td>Conducted initial evaluation of improved accuracy assessment measurement methodology.</td> </tr> <tr> <td>-</td> <td>(U) \$500</td> <td>Completed necessary Safety Enhanced Reentry Vehicle (SERV) acquisition documentation and conducted Phase I activities.</td> </tr> <tr> <td>-</td> <td>(U) \$9,639</td> <td>Total</td> </tr> </table>												-	(U) \$2,624	Continued to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.	-	(U) \$1,385	Designed, developed, and conducted prototype testing of selected aging prediction techniques and tools.	-	(U) \$1,781	Designed, developed, and conducted prototype testing of selected fuze assessment/measurement methodologies.	-	(U) \$1,583	Designed, developed, and conducted prototype testing of selected sensors/instruments.	-	(U) \$480	Identified and ground tested potential replacement options for critical RV components.	-	(U) \$1,286	Conducted initial evaluation of improved accuracy assessment measurement methodology.	-	(U) \$500	Completed necessary Safety Enhanced Reentry Vehicle (SERV) acquisition documentation and conducted Phase I activities.	-	(U) \$9,639	Total
-	(U) \$2,624	Continued to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.																																	
-	(U) \$1,385	Designed, developed, and conducted prototype testing of selected aging prediction techniques and tools.																																	
-	(U) \$1,781	Designed, developed, and conducted prototype testing of selected fuze assessment/measurement methodologies.																																	
-	(U) \$1,583	Designed, developed, and conducted prototype testing of selected sensors/instruments.																																	
-	(U) \$480	Identified and ground tested potential replacement options for critical RV components.																																	
-	(U) \$1,286	Conducted initial evaluation of improved accuracy assessment measurement methodology.																																	
-	(U) \$500	Completed necessary Safety Enhanced Reentry Vehicle (SERV) acquisition documentation and conducted Phase I activities.																																	
-	(U) \$9,639	Total																																	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
1022

## 4 - Demonstration and Validation

0603851F ICBM Dem/Val

## (U) FY 1998 (\$ in Thousands):

- (U) \$3,724 Continue to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.
- (U) \$1,660 Continue to design, develop, and conduct prototype testing of selected aging prediction techniques and tools.
- (U) \$2,550 Continue to design, develop, and conduct prototype testing of selected fuze assessment/measurement methodologies.
- (U) \$2,440 Continue to design, develop, and conduct prototype testing of selected sensors/instruments.
- (U) \$530 Continue identifying and ground testing of potential replacement options for critical RV components.
- (U) \$1,540 Continue evaluation of improved accuracy assessment methodology.
- (U) \$12,444 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$4,201 Continue to evaluate existing RV material subsystems and potential material replacements by performing applicable ground and flight tests.
- (U) \$2,023 Evaluate force applications technologies to comply with evolving AF global studies.
- (U) \$2,534 Continue design, develop, and conduct prototype testing of selected fuze assessment/measurement methodologies.
- (U) \$2,712 Continue design, develop, and conduct prototype testing of selected sensors/instruments.
- (U) \$692 Continue identifying and ground testing of potential replacement options for critical RV components.
- (U) \$1,220 Continue evaluation of improved accuracy assessment methodology.
- (U) \$13,382 Total

## (U) B. Program Change Summary (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Total</u> <u>Cost</u>
(U) Previous President's Budget (FY 1998 PB)	9,639	13,123	14,651	Continuing
(U) Appropriated Value	10,123	13,123		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-228	-573		
b. SBIR	-256	-106		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-1,269	
(U) Current Budget Submit/FY 1999 President's Budget	9,639	12,444	13,382	Continuing

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(U) Change Summary Explanation:

Funding: FY99 funding reduction to fund other AF and DoD priorities.

Schedule: Selected studies/analyses will be deferred until FY01, such as the planned RV Recovery task.

Technical: No significant impact.

(U) C. Other Program Funding Summary (\$ in Thousands): None.

## (U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) Complete SERV Acquisition Docs									
(U) Continue Evaluation of Materials; Identify Replacements				X*					
Complete Ground/Flight Tests									
Design/Develop/Test of Selected Technologies								X	
(U) Aging Prediction Methodologies								X	
Design/Develop/Test of Selected Technologies									
(U) Sensor/Instrumentation Integration									
Design/Develop/Test of Sensors & Instruments									
(U) Assessment Methodology									
Evaluation of Accuracy Measurement Techniques									
(U) Fuze Assessment									
Design/Develop/Test of Measurement Tools									
(U) Critical Components									
Design/Develop/Test of Replacement Options									
(U) Force Application Evaluations - Identify/Evaluate Options									
* Started and/or Completed									

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## (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Contract Engineering Support	9,390	12,167	12,836
(U) Other Engineering Costs	249	277	546
(U) Total	9,639	12,444	13,382

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
----------------------------------------------	-----------------------------------------	--------------------------	-------------------------	--------------------	------------------------	----------------	---------	---------	--------------------	---------------

### Product Development Organizations

Textron	C/CPAF	Various	Continuing	Continuing	1,826	2,840	3,970	3,510	Continuing	Continuing
Lockheed-Martin	C/CPAF	Various	Continuing	Continuing	3,622	4,550	5,350	5,380	Continuing	Continuing
Boeing-North American	C/CPAF	Various	Continuing	Continuing	0	0	560	3,128	Continuing	Continuing

### Support and Management Organizations

TRW	SS/CPAF	Oct 95	2,800	2,800	1,296	1,201	236	0	0	2,733
TRW (Prime)	C/CPAF	Dec 97	Continuing	Continuing	0	0	364	388	Continuing	Continuing
Other Engineering & Management Support	Various	Ongoing	Continuing	Continuing	269	698	1,534	546	Continuing	Continuing

### Test and Evaluation Organizations

Wright Lab	MIPR	Annual	Continuing	Continuing	406	80	85	80	Continuing	Continuing
AEDC	MIPR	n/a	300	300	300	270	345	350	Continuing	Continuing

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
4 - Demonstration and Validation		0603851F ICBM Dem/Val		1022	
Government Furnished Property: None.					
	Total	Budget	FY 1998	FY 1999	Budget to
	Prior to	FY 1997			Complete
	FY 1997				Program
Subtotal Product Development	5,448	7,390	9,880	12,018	Continuing
Subtotal Support and Management	1,565	1,899	2,134	934	Continuing
Subtotal Test and Evaluation	706	350	430	430	Continuing
Total Project	7,719	9,639	12,444	13,382	Continuing

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COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1023 Rocket System Launch Program (RSLP) Applications	17,220	15,202	31	33	35	33	34	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification

(U) This task supports studies/analysis on hardware for cost effective use on excess missile assets.

(U) FY 1997 (\$ in Thousands):

- (U) \$31 Continued studies/analyses for the adoption of low cost front-end systems for use on deactivated missile assets.
- (U) \$458 Initiated studies/analyses to support storage of excess Peacekeeper-unique handling equipment.
- (U) \$2,000 Developed GPS range safety modifications.
- (U) \$14,731 Developed improved accuracy capabilities for conventional ICBM precision strike.
- (U) \$17,220 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$31 Continue study/analysis for the adoption of low cost front-end systems for use on deactivated missile assets.
- (U) \$14,850 Develop capabilities for Conventional Ballistic Missile (CBM) precision delivery Advanced Concept Technology Demonstration (ACTD) Program.
- (U) \$321 Pending reprogramming to fund higher priorities.
- (U) \$15,202 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$31 Continue study/analysis for the adoption of low cost front-end systems for use on deactivated missile assets. (One task only)
- (U) \$31 Total

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## 4 - Demonstration and Validation

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget (FY 1998 PB)	17,838	31	32	
(U) Appropriated Value	18,731	16,531		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-394	-539		
b. SBIR	-499	-790		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescission	-166			
f. Other	-452			
(U) Adjustments to Budget Years Since FY 1998 PB			-1	
(U) Current Budget Submit/FY 1999 President's Budget	17,220	15,202	31	Continuing
(U) Change Summary Explanation (\$ in thousands):				

Funding: Congress added \$16,500 to FY98 request to establish a Conventional Ballistic Missile (CBM) Advanced Concept Technology Demonstration. FY97 funding adjustments include \$452 transferred to Guidance Applications (BPAC 1020, this PE) to pay for congressional reductions erroneously assessed against that BPAC. Other reductions to offset higher Air Force and DoD needs.

Schedule: No significant impact.

Technical: Initiated a CBM ACTD program in FY98 per congressional direction.

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(U) C. Other Program Funding Summary (\$ in Thousands): None.

**(U) D. Schedule Profile**

	FY 1997	FY 1998	FY 1999
(U) Start/Complete Annual Multiservice	1 X*	4 X*	1 X
	2 3	2 3	2 3

(U) Start/Complete Handling Equipment	X*	X*

**(U) GPS Range Safety & Improved Accuracy Analysis**

\* Started and/or Completed

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(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Studies/Analysis	489	31	31
(U) GPS Range Safety/Improved Accuracy	16,731	14,850	
(U) Other - Pending Reprogramming		321	
(U) Total	17,220	15,202	31

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Textron	C/CPFF	30 Apr 97	4,900	4,900	0	4,900				4,900
TBD	C/CPIF	Feb 98	TBD	3,000	0	3,000				3,000
TBD	C/CPIF	Mar 98	TBD				12,100			12,100
Phillips Lab	MIPR	30 Mar 97	3,004	3,004	0	2,504	500			3,004
Wright Lab	MIPR	30 Mar 97	900	900	0	900				900
National Guard (FL)	MIPR	1 Jul 97	2,500	2,500	0	2,500				2,500
Various	Various	Various	Continuing	Continuing	0	700	450		Continuing	Continuing
<u>Support and Management Organizations</u>										
TRW/SETA	SS/T&M	15 Mar 97	1,527	1,527	0	1,527	1,800			3,327
Various	Various	Ongoing	Continuing	Continuing	28	489	31	31	Continuing	Continuing
Other - Pending Reprogramming							321			321
<u>Test and Evaluation Organizations</u>										
AEDC	MIPR	Feb 98	700	700	0	700				700

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Government Furnished Property: None.

	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Subtotal Product Development	0	14,504	13,050	0	Continuing	Continuing
Subtotal Support and Management	28	2,016	2,152	31	Continuing	Continuing
Subtotal Test and Evaluation	0	700	0	0	0	700
Total Project	28	17,220	15,202	31	Continuing	Continuing

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BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603851F ICBM Dem/Val								1024	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
1024	ICBM Command & Control (C2) Applications	1,051	181	185	184	181	451	447	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification</u></p> <p>(U) The deMIRVing of ICBMs and overall cutbacks in the number of nuclear weapons reduce the incentive to attack individual ICBM silos. Therefore, the incentive to attack Minuteman launch control centers will increase unless steps are taken to lessen an aggressor's confidence in being able to prevent missile launch by simultaneously destroying all launch control centers. This program funds efforts to identify existing technologies (Ground Launch Cruise Missile, Small ICBM, Airborne Launch Control Centers, etc.) to increase the uncertainty of destroying Minuteman launch control center capabilities. The identification and use of existing military hardware, software, and system designs/documentation are principle concerns. Additionally, it is critical to explore ways of continuing assured connectivity to strategic forces. Study efforts will be conducted to ensure reliable and standardized communication links are maintained between the ICBM forces and higher authorities. Testing of existing low cost technology (fiber optic cable, telescoping antennas, etc.) under heightened states of alert of both simulated and actual readiness scenarios will be conducted. Methods to further disengagement strategies and achieve additional cost savings will also be pursued.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$173 Completed EHF studies to include identifying a single terminal option and a cost analysis.</li> <li>- (U) \$878 Identified technical and cost options for providing future command, control, communications, and computer (C4) elements and alternatives [e.g., Defense Improved Emergency Message Automated Transmission System (IEMATS) Replacement Command and Control Terminal (DIRECT Program)].</li> <li>- (U) \$1,051 Total</li> </ul> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$181 Examine Strategic Automated Command and Control System (SACCS) and other ICBM command, control, and communication (C3) systems for turn-of-the-century (i.e., treaty) implications. (Only task.)</li> <li>- (U) \$181 Total</li> </ul> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$185 Accomplish analysis for the Fiber Optic Link/Hardened Intersite Cable System (HICS) upgrade. (Only task.)</li> <li>- (U) \$185 Total</li> </ul>											

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**(U) B. Program Change Summary (\$ in Thousands)**

(U) Previous President's Budget (FY 1998 PB)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

### a. Cong Gen Reductions

**b. SBIR**

c. Omnibus or Other Above Threshold Reprogram

d. Below Threshold Reprogramming

### e. Rescission

(U) Adjustments to Budget Years Since FY 1998 PB

(U) Current Budget Submit/FY 1999 President's Budget

(U) Change Summary Explanation:

**Funding:** No significant changes.

**Schedule: No significant impact.**

**Technical:** No significant impact.

(U) C. Other Program Funding Summary (\$ in Thousands): None.

**(U) D. Schedule Profile**

	FY 1997	FY 1998	FY 1999
(U) Complete Milstar EHF	1	4	1
(U) Fiber optic link/HICS Upgrade	2	3	2
	X*		
			X
			X

(U) Complete Milstar EHF

(U) Fiber optic link/HICS Upgrade

(U) Future C4 Study & Analysis

(U) SACCS/Turn-of-Century Study &

## Analysis

\* Started and/or Completed

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)					DATE	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE				
4 - Demonstration and Validation		0603851F ICBM Dem/Val				1024
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>						
		<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>		
(U)	Contract Engineering Support	1,042	174	181		
(U)	Program Management	9	7	4		
(U)	Total	1,051	181	185		
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>						
Performing Organizations:						
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997
Product Development Organizations						
Support and Management Organizations						
Various	Various	Ongoing	n/a	n/a	496	173
GTE	SS/CPAF		878	878		878
TRW (Prime)	C/CPAF	Dec 97	n/a	n/a	0	0
Test and Evaluation Organizations						
None						
Government Furnished Property: None.						
		<u>Total Prior to FY 1997</u>	<u>Budget FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>Budget to Complete</u>
						<u>Total Program</u>
Subtotal Product Development		496	1,051	181	185	Continuing
Subtotal Support and Management						Continuing
Subtotal Test and Evaluation						Continuing
Total Project		496	1,051	181	185	Continuing
Project 1024						
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BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603851F ICBM Dem/Val								4209	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4209	Long Range Planning (LRP)	2,093	2,303	2,299	2,230	2,318	2,436	2,410	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification</u></p> <p>(U) The Long Range Planning (LRP) task analyzes ICBM systems to identify potential modifications required to meet user objectives relative to long term sustainment, technology insertion, employment, and force structure. The studies focus on system supportability, operability, reliability, and maintainability. Options/concepts generated by these studies are evaluated for feasibility, system impacts, and cost.</p> <p>(U) <u>FY 1997 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$535 Supported Long Range Planning tasks, developed of the Systems Options Report, and updated the Logistics Program Management Plan and the ICBM Master Plan.</li> <li>- (U) \$648 Performed feasibility studies in direct support of Minuteman life extension.</li> <li>- (U) \$910 Performed technology insertion studies in support of changing ICBM environments.</li> <li>- (U) \$2,093 Total</li> </ul> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$619 Continue support of Long Range Planning tasks, development of the Systems Options Report, and update of the Logistics Program Management Plan and the ICBM Master Plan.</li> <li>- (U) \$940 Continue feasibility and life extension studies.</li> <li>- (U) \$744 Continue technology insertion studies in support of changing ICBM environments.</li> <li>- (U) \$2,303 Total</li> </ul> <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> <li>- (U) \$630 Continue support of Long Range Planning tasks, development of the Systems Options Report, and update of the Logistics Program Management Plan and the ICBM Master Plan.</li> <li>- (U) \$925 Continue to perform feasibility and life extension studies.</li> <li>- (U) \$744 Continue to perform technology insertion studies in support of changing ICBM environments.</li> <li>- (U) \$2,299 Total</li> </ul>											

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(U) B. Program Change Summary (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	Total Cost Continuing
(U) Previous President's Budget (FY 1998 PB)	2,093	2,465	2,345	
(U) Appropriated Value	2,198	2,465		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-50	-105		
b. SBIR	-55	-57		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-46	
(U) Current Budget Submit/FY 1999 President's Budget	2,093	2,303	2,299	Continuing

## (U) Change Summary Explanation:

Funding: No significant changes.

Schedule: No significant impact.

Technical: No significant impact.

(U) C. Other Program Funding Summary (\$ in Thousands): None.(U) D. Schedule Profile

	<u>FY 1997</u>			<u>FY 1998</u>			<u>FY 1999</u>		
	1	2	3	4	1	2	3	4	
(U) Contract Award	X*								
(U) Program Reviews					X*				
(U) Deliverable Reports		X*	X*		X	X	X		
* Started and/or Completed			X*					X	

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)									
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4 - Demonstration and Validation		0603851F ICBM Dem/Vai				February 1998			
						4209			
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>									
				<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>			
(U) Contractor Engineering Support				1,945	2,158	2,151			
(U) Program Management Support				148	145	148			
(U) Total				2,093	2,303	2,299			
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>									
<u>Performing Organizations:</u>									
Contract or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete Total Program
<u>Product Development Organizations</u>									
TRW	SS/CPAF	Oct 95	7,616	7,616	3,823	1,945	1,848	0	7,616
TRW (Prime)	C/CPAF	Dec 97	n/a	n/a	0	0	325	2,151	Continuing
<u>Support and Management Organizations</u>									
Various	Various	Ongoing	n/a	n/a	1,520	148	130	148	Continuing
<u>Test and Evaluation Organizations: None</u>									

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Government Furnished Property: None.

	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Subtotal Product Development	3,823	1,945	2,173	2,151	Continuing	Continuing
Subtotal Support and Management	1,520	148	130	148	Continuing	Continuing
Subtotal Test and Evaluation						
Total Project	5,343	2,093	2,303	2,299	Continuing	Continuing

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BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603852F C-130J Dem/Val								4025	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4025 C-130J Dem/Val		0	3,741	0	0	0	0	0	0	0	8,871
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

The C-130J is the next generation C-130. The weapon system incorporates a redesigned 2-crewmember flight station, a modern technology propulsion system, and an integrated digital avionics subsystem. The program modernizes the fleet of Weather Reconnaissance (WC-130) and Special/Psychological (EC-130) aircraft. Additionally, this program continues a theater airlift modernization effort to replace aging C-130E/Hs. USAF has concluded a vulnerability assessment that shows no significant difference in vulnerability between "H" and "J" model aircraft. However, USAF will conduct a vulnerability reduction program to explore the potential to further reduce the chance of wing leading edge and dry bay fires (applicable to the entire C-130 fleet) and to test the new six-bladed composite propeller. This program is in BA4, Demonstration and Validation, because this effort conducts Live Fire Testing (LFT) and the military utility testing of an Air Force unique system.

**Acquisition Strategy**

USD (A&T) designated the C-130J program a Regulatory Pilot Program, and the USAF is purchasing the C-130J as a commercial item. Consequently, the Service Milestone Decision Authority (MDA) has directed the program use commercial practices and that all contract provisions, review documents, and plans be streamlined to the maximum extent possible. The MDA conducted a Commercial Acquisition Review and Approval prior to contract award in 1996. The Air Force negotiated and awarded a Firm Fixed Price (FFP) type contract with a FY96 base year and FFP options for four additional years. Contract options will provide prices for variable quantities to accommodate program, budget, and appropriation changes. The C-130 Program Office executes acquisition of C-130J and derivative aircraft for the active Air Force, Air National Guard, Air Force Reserve, other military services, other government agencies, and selected Foreign Military Sales. All US Government C-130 aircraft are priced on a standard USAF C-130J configuration. Equipment, components, or services for unique USAF mission requirements, or for other customers, will be negotiated separately.

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603852F C-130J Dem/Val

4025

### (U) FY 1997 (\$ in Thousands):

- (U) \$0 Total

### (U) FY 1998 (\$ in Thousands):

- (U) Live Fire Component Testing (Dry Bay and Propeller)  
 - (U) 3,491 Dry Bay Testing  
 - (U) 0 Propeller Testing (unfunded)  
 - (U) 250 Mission Support  
 - (U) \$3,741 Total

### (U) FY 1999 (\$ in Thousands):

- (U) \$0 Total

### (U) B. Program Change Summary (\$ in Thousands)

#### (U) Previous President's Budget (FY1998 PB)

#### (U) Appropriated Value

#### (U) Adjustments to Appropriated Value

a. Congressional/ General Reductions

b. SBIR

c. Omnibus or Other Above Threshold Reprogram

d. Below Threshold Reprogramming

e. Rescissions

#### (U) Adjustments to Budget Years Since FY1998 PB

#### (U) Current Budget Submit/1999 President's Budget

\* Total cost detailed in R-3

#### (U) Change Summary Explanation:

Funding: FY98 reflects \$134K in Congressional reductions and \$93K for SBIR.

Schedule: N/A

Technical: N/A

Total\*  
Cost  
9,098

FY 1997

0

FY 1998

3,968

3,968

-134

-93

FY 1999

0

8,871

Project 4025

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Exhibit R-2 (PE 0603852F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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PROJECT

## 4 - Demonstration and Validation

0603852F C-130J Dem/Val

4025

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) <u>APAF Budget Activity 02, Other Airlift</u>	304,209	244,388	125,734	0	0	137,893	142,467	TBD	TBD
PE 0401115F (FY97-98 & FY02-03);									
PE 0401132F (FY98-03)	5	3	1	0	0	2	2	TBD	TBD
(Aircraft Quantity)									

(U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1	2	3	4	1	2	3	4

(U) Acquisition Milestones  
 (U) H/J Swap Contract (4Q/FY95)  
 (U) Follow-on Proposal (2Q/FY96)  
 (U) Commercial Acquisition Rev & Approval  
 (U) Follow-on Contract  
 (U) First Delivery to USAF

\*

X

X

(U) Engineering Milestones  
 (U) Rollout - First USAF Aircraft (1Q/FY96)  
 (U) First Flight (3Q/FY96)  
 (U) Vulnerability Assess. Comp. (4Q/FY96)  
 (U) Begin Live Fire Test  
 (U) Complete Live Fire Test

X

X

Project 4025

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

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February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603852F C-130J Dem/Val

4025

## (U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

Government Furnished Property: TBD

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total					
				Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development				0	0	0	0	0	0
Subtotal Support and Management				250	250	250	500	500	500
Subtotal Test and Evaluation				4,880	3,491	3,491	8,371	8,371	8,371
Total Project				5,130	3,741	3,741	8,871	8,871	8,871

Project 4025

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Exhibit R-3 (PE 0603852F)

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PE NUMBER: 0603853F

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PE TITLE: Evolved Expendable Launch Veh (EELV) (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PROJECT	
4 - Demonstration and Validation										0006	
PE NUMBER AND TITLE										0603853F Evolved Expendable Launch Veh (EELV) (Space)	
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
0006 Evolved Expendable Launch Vehicle	44,263	60,437							173,153		
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

**(U) A. Mission Description and Budget Item Justification:**

The Evolved Expendable Launch Vehicle (EELV) program is a space launch system development program. The mission of the EELV program is to partner with industry to develop a national launch capability that satisfies the Government's National Mission Model (NMM) requirements and reduces the cost of space launch by at least 25%. The EELV system includes the launch vehicles, infrastructure, support systems, and interfaces. EELV will provide up to two families of launch vehicles that will launch the Government portion of the NMM currently serviced by Titan II, Delta II, Atlas II, and Titan IV. Evolved from current expendable launch systems or components thereof, EELV will support military, intelligence, and civil mission requirements. This program element is in Budget Activity 4, Demonstration and Validation, because it supports risk reduction, demonstration and validation of technologies, and concept verifications leading to lower cost expendable launch vehicles.

**(U) Acquisition Strategy:**

The EELV concept of a family of launch vehicles emphasizes commonality of hardware and infrastructure and economies of scale to enhance production, operations, and support efficiencies. Cost improvements will be achieved through commonality; leveraging the commercial market place; reduction of supporting infrastructure (launch pads, manufacturing facilities, workforce); and optimization of production and launch operations, processes, and rates. EELV is an ongoing competitive program that initially used a rolling downselect acquisition strategy. In August 1995 four initial contracts were awarded for the Low Cost Concept Validation (LCCV) phase. In December 1996 the Air Force downselected to two contractors - Lockheed Martin and Boeing (originally McDonnell Douglas) - for the Pre-Engineering and Manufacturing Development (Pre-EMD) phase. In the summer of 1998, contracts will be awarded for the Engineering and Manufacturing Development (EMD) and Initial Launch Services (ILS) phase. The EMD/ILS approach maintains competition throughout the life of the program, leverages the growing commercial launch market, caps the Government's EMD costs, and allows partnership with industry, while still reducing the program's overall cost to launch the NMM by at least 25% over existing systems. The EELV system will launch the government portion of the NMM through 2020.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	
4 - Demonstration and Validation		0603853F Evolved Expendable Launch Veh (EELV) (Space)	
(U) FY 1997 (\$ in Thousands)			
-	(U) \$39,734 EELV Pre-EMD system design.		
-	(U) \$1,142 Systems Engineering.		
-	(U) \$3,387 Program management and other support costs.		
-	(U) \$44,263 Total		
(U) FY 1998 (\$ in Thousands)			
-	(U) \$55,900 Continue EELV Pre-EMD system design and demonstrate readiness to proceed into EMD.		
-	(U) \$3,714 Systems Engineering.		
-	(U) \$823 Program management and other support costs.		
-	(U) \$0 EMD funded under PE 0604853F beginning June 98.		
-	(U) \$60,437 Total		
(U) FY 1999 (\$ in Thousands)			
-	(U) \$0 Not Applicable. EELV funded by PE 0604853F.		
(U) B. Program Change Summary (\$ in Thousands)			
(U) Previous President's Budget (FY 1998 PB)		FY 1997	FY 1998
(U) Appropriated Value		42,333	63,260
(U) Adjustments to Appropriated Value		44,457	63,260
a. Congressional General Reductions		-1,003	-2,823
b. Small Business Innovative Research		-1,121	
c. Omnibus or other above threshold reprogramming		2,000	
d. Below Threshold Reprogramming		-70	
e. Rescissions			
(U) Adjustments to Budget Years Since FY98 PB			
(U) Current Budget Submit/FY 1999 President's Budget		44,263	60,437
			0
			173,153
			Total
			174,033

Project 0006

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Exhibit R-2 (PE 0603853F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603853F Evolved Expendable Launch Veh  
(EELV) (Space)

0006

(U) Change Summary Explanation:

- Funding: The FY98 changes are Congressional reductions of \$2.823M.
- Schedule: Not Applicable.
- Technical: Not Applicable.

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Comp	Total
(U) NRO (Non-AF budget)	18,600	4,200						0	95,100*
(U) Missile Procurement, AF (PE 0305953F)				204,576	360,818	359,442	599,717	Cont.	Cont.
(U) DARPA (Non-AF budget) (PE 0603226E)									9,845**
<b>Related RDT&amp;E</b>									
(U) EELV EMD (PE 0604853F)		26,572	280,297	338,319	305,557	244,450	14,822	Cont.	1,210,017
(U) EELV Operational System Development (PE 0305953F)			3,316	3,397	3,477	2,320	766	Cont.	Cont.

\* Total includes funding in FY96.

\*\* Total includes funding in FY94.

## (U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999
1	2	3	4
2	3	4	1
3	4	1	2
4	1	2	3
5	2	3	4

**LCCV Module**

(U) Defense Acquisition Board (DAB) -

Milestone I \*

(U) Downselect to two contracts \*

**Pre-EMD Module**

(U) Pre-EMD contract awards \*

(U) Downselect Design Review

(U) EMD DAB - Milestone II

(U) Development/Initial Launch Services

contract awards

\* Actual Event

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603853F Evolved Expendable Launch Veh  
(EELV) (Space)

0006

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Concept Development Contracts	39,734	55,900	0
(U) Systems Engineering	1,142	3,714	0
(U) Program management and other support costs	3,387	823	0
(U) Total	44,263	60,437	0

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)\*

\* Information represents only Air Force funds. Does not include DARPA funding of FY94 \$9,845 and NRO funding of: FY96 \$72,300, FY97 \$18,600, FY98 \$4,200.

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
----------------------------------------------	-----------------------------------------	--------------------------	-------------------------	--------------------	------------------------	----------------	----------------	----------------	--------------------	---------------

#### Product Development Organizations

Alliant Tech	C/FFP (LCCV)	Aug 95	13,000	13,000	13,000	0	0	0	0	13,000
Boeing	C/FFP (LCCV)	Aug 95	13,000	13,000	13,000	0	0	0	0	13,000
Lockheed Martin	C/FFP (LCCV)	Aug 95	13,000	13,000	13,000	0	0	0	0	13,000
McDonnell Douglas	C/FFP (LCCV)	Aug 95	13,000	13,000	13,000	0	0	0	0	13,000
Lockheed Martin	C/FFP (Pre-EMD)	Dec 96	49,327	49,327	0	19,867	27,950	0	0	47,817
Boeing*	C/FFP (Pre-EMD)	Dec 96	49,327	49,327	0	19,867	27,950	0	0	47,817

\* McDonnell Douglas became Boeing via merger in Aug 97.

#### Support and Management Organizations

SPO Mission Spt	Various	Various	N/A	N/A	2,011	1,459	763	0	0	4,233
FFRDC	SS/CPAF	Annual	N/A	N/A	3,554	1,142	3,714	0	0	8,410
Ranges	Various	Various	N/A	N/A	9,014	157	60	0	0	9,231
Other Cntr Spt	Various	Various	N/A	N/A	1,874	1,771	0	0	0	3,645

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE										0006
4 - Demonstration and Validation		0603853F Evolved Expendable Launch Veh (EELV) (Space)										
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	0	
Test and Evaluation Organizations												
Not Applicable												
Government Furnished Property: Not Applicable												
Subtotal Product Development												
Subtotal Support and Management												
Subtotal Test and Evaluation												
Total Project												
					0	0	0	0	0	0	0	
					52,000	39,734	55,900	0	0	147,634		
					16,453	4,529	4,537	0	0	25,519		
					68,453	44,263	60,437	0	0	173,153		

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PE NUMBER: 0603854F

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PE TITLE: Global Broadcast Service (GBS) (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0603854F Global Broadcast Service (GBS) (Space)								2679	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2679	Global Broadcast Service (GBS)	33,094	54,089	70,147	54,315	134,817	258,735	360,507	1,812,347	2,792,051	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	
<p><b>Note:</b> The amounts reflected above include these three efforts:</p> <ul style="list-style-type: none"> <li>- GBS Phases 1 &amp; 2</li> <li>- Wideband Gapfiller MILSATCOM</li> <li>- Advanced Wideband MILSATCOM (w/ GBS Ph 3)</li> </ul> <p>Beginning with the FY00 budget documentation, these three efforts will be reflected as separate projects.</p>											
<p><b>(U) A. Mission Description and Budget Item Justification</b></p> <p>Acquire a three-phased Global Broadcast Service (GBS) program which will provide a worldwide, satellite-based, high data rate communications broadcast capability in accordance with the Mission Need Statement approved by the Joint Requirements Oversight Council (JROC) in Aug 95. Acquire a Wideband Gapfiller system, and plan for a subsequent Advanced Wideband system, to host continued GBS, to continue appropriate services now provided by the DSCS system, and to provide a new two-way Ka-band service in accordance with Joint Space Management Board direction based on the Aug 96 MILSATCOM Architecture and recommendations from the Senior Warfighters Forum during the 1997 MILSATCOM Transition analysis. The Air Force was designated executive agent for the GBS Program by USD(A&amp;T) on 27 Mar 96.</p> <p>GBS will provide efficient high data rate connectivity between many distributed information sources and warfighters who receive the broadcast directly on small, inexpensive user terminals. Broadcast data includes digitized imagery, logistics data, weather data, maps, operational orders (e.g., Air Tasking Order), and video. Phase One was started in 1996 and uses commercial satellite leases to provide a CONUS-based testbed for requirements definition and operational concept refinement. Phase Two will be available for first launch in 1998, and provide a near worldwide GBS capability at military frequencies hosted on the last three UHF Follow-On (UFO) satellites (numbers 8, 9, and 10). Phase Three will provide a global capability at military frequencies hosted on a conceptual Advanced Wideband satellite. The Gapfiller and Advanced Wideband systems will be procured making maximum use of commercial technology and practices. The 3 Gapfiller satellites will be launched in 2004-5 and will contain GBS Phase 2 equivalent service. The ~5 Advanced Wideband satellites will begin launching ~2008 and host GBS Phase 3. Funding is in Budget Activity 4, Demonstration and Validation, since it supports Global Broadcast Service technology demonstration and validation.</p> <p>Note: Funding profile shown does not reflect \$21.3M FY98 RDT&amp;E funds required to align GBS program funding with the Joint Service Cost Position. The Air Force is submitting an Above Threshold Reprogramming (ATR) request to address this funding shortfall and a \$2.1M FY98 O&amp;M shortfall.</p> <p>Acquisition Strategy: Evolutionary acquisition approach making maximum use of commercial acquisition practices and technology. Single integration contractor with total system performance responsibility. (Navy providing space segment for Phase 2 and adapting common receive terminal equipments for shipboard installation.)</p>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603854F Global Broadcast Service (GBS) (Space) 2679

## (U) FY 1997 (\$ in Thousands)

- (U)\$ 3,691 Testbed Transponder, Transition and Lease  
 - (U)\$ 1,116 Field Engineering and Demonstration Support  
 - (U)\$ 3,900 UFO GBS Payload  
 - (U)\$ 13,886 System Development and Test  
 - (U)\$ 10,263 Phase 2 Government System Integration  
 - (U)\$ 202 Field Survey and Integration  
 - (U)\$ 36 System Test & Eval Support  
 - (U)\$ 33,094 Total

## (U) FY 1998 (\$ in Thousands):

- (U)\$ 3,278 Testbed Transponder, Transition, and Lease  
 - (U)\$ 2,297 Field Engineering and Demonstration Support  
 - (U)\$ 27,704 System Development and Test  
 - (U)\$ 2,000 Initial Communications Connectivity/Interface  
 - (U)\$ 11,908 Phase 2 Government System Integration  
 - (U)\$ 632 Field Survey and Integration  
 - (U)\$ 6,000 Navy Terminals  
 - (U)\$ 199 Joint Spectrum Center  
 - (U)\$ 71 System Test & Eval Support  
 - (U)\$ 54,089 Total

## (U) FY 1999 (\$ in Thousands):

- (U)\$ 44,380 System Development and Test  
 - (U)\$ 6,304 Initial Comm Connectivity/Interface, CONUS Transponder Lease  
 - (U)\$ 12,591 Phase 2 Government System Integration  
 - (U)\$ 666 Field Survey and Integration  
 - (U)\$ 6,000 Navy Terminals  
 - (U)\$ 70 Joint Spectrum Center  
 - (U)\$ 136 System Test & Eval Support  
 - (U)\$ 70,147 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603854F Global Broadcast Service (GBS) (Space)

2679

## (U) B. Program Change Summary (\$ in Thousands)

(U) Previous President's Budget (FY 1998)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

a. Congressional General Reductions

b. SBIR

c. Omnibus and Other Above Threshold Reprogram

d. Below Threshold Reprogram

e. Rescissions

(U) Adjustments to Budget Years Since FY98 PB

(U) Current Budget Submit /FY 1999 President's Budget

FY 1997

43,565

45,000

-1,024

-411

-7,300

-3,099

-72

33,094

FY 1998

56,977

56,977

-2,888

54,089

FY 1999

62,678

+7,469

70,147

Total

3,141,000

2,792,051

## (U) Change Summary Explanation:

Funding: FY97 Below Threshold Reprogramming actions (Global Positioning System: -\$1,100; MILSATCOM Terminals: -\$1,999). FY99 increase aligned GBS funding with the Joint Service Cost Position. Air Force GBS Receive Terminals were transferred to PE 33601F, MILSATCOM Terminals, and reclassified to the other procurement appropriation. FY97-FY99 includes GBS Ph 1&2 only. Total cost includes: \$431.2M for GBS Ph 1&2, \$960.9M for Wideband Gapfiller, and \$1,400.0M for Advanced Wideband

Schedule: If FY98 funding is not received, Phase 2 IOC will slip from FY99 to FY01. Three Gapfiller Wideband satellites with GBS Phase 2-like capabilities were added and are scheduled for a FY04 first launch. Advanced Wideband satellites, with GBS Phase 3 payload, will begin launching ~2008 vice in 2006.

Technical: Not Applicable.

## (U) C. Other Program Funding Summary (\$ in Thousands)

Related RDT&amp;E

(U) None

Other Appropriations

(U) Air Force GBS receive terminals. Included in BPAC 836780, line P-67 -- PE 33601, Milstar Satellite Comm Sys, Other Procurement, AF

(U) Navy SATCOM Ship Terminal Programs

(U) Army Ground Terminal Programs

(U) Navy UFO Program

(U) ARPA-DISA Bosnia Operational Communications Augmentation (BOCA) and Joint Broadcast Service (JBS)

(U) ARPA Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technical Demonstration (ACTD)

(U) DISA Long Haul Communications

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603854F Global Broadcast Service (GBS) (Space)

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(U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) Phase I (96-98)									
(U) Joint Warfighter Interoperability Demos (JWID)				x					
(U) Lease Commercial Transponder				x					
(U) Phase II (98-00+)									
(U) Acquisition Program Reviews - TBD									
(U) Launch UFO #8 (Feb/Mar 98)									
(U) Launch UFO #9 (Aug/Oct 98)									
(U) Launch UFO #10 (Feb/Mar 99)									
(U) Gapfiller Satellites - 3 satellites w/GBS payload (2004/2005)									
(U) GBS Phase 2 Acquisition Milestone Reviews									
(U) Initial Wideband Gapfiller Launch (2008)									

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603854F Global Broadcast Service (GBS) (Space) 2679

### (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Testbed Transponder, Transition, and Lease	3,691	3,278	0
(U) Field Engineering and Demonstration Support	1,116	2,297	0
(U) UFO GBS Payload	3,900	0	0
(U) System Development and Test	13,886	27,704	44,380
(U) Communication Connectivity/Interface	0	2,000	6,304
(U) Phase 2 Government System Integration	10,263	11,908	12,591
(U) Field Survey and Integration	202	632	666
(U) Navy Terminals	0	6,000	6,000
(U) Joint Spectrum Center	0	199	70
(U) System Test & Eval Support	36	71	136
(U) Total	33,094	54,089	70,147

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations										
Raytheon Sys Co	CPAF	18 Nov 97			7,975	14,524	16,707	42,281	51,656	125,168
Government/TBD						8,069	24,572	14,403	2,504,030	2,559,049
Support and Management Organizations					6,025	10,465	12,739	13,327	64,670	107,226
Various					0	36	71	136	365	608
Test and Evaluation Organizations										
Support for Development & Operational Testing										

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT	
BUDGET ACTIVITY			PE NUMBER AND TITLE							0603854F Global Broadcast Service (GBS) (Space)			2679
4 - Demonstration and Validation													
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program			
Government Furnished Property:													
Product Development Property - TBD													
Support and Management Property - TBD													
Test and Evaluation Property - TBD													
Subtotal Product Development													
Subtotal Support and Management													
Subtotal Test and Evaluation													
Total Project													
Program inception (FY96) through FY99 include GBS Ph 1&2 only. Total cost includes: \$431.2M for GBS Ph 1&2, \$960.9M for Wideband Gapfiller, and \$1,400.0M for Advanced Wideband.													

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Exhibit R-3 (PE 0603854F)

PE NUMBER: 0603856F

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PE TITLE: Air Force/NRO Partnership (AFNP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
<b>4 - Demonstration and Validation</b>		<b>0603856F Air Force/NRO Partnership (AFNP)</b>								<b>4782</b>	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4782	Air Force/NRO Partnership	0	0	17,645	0	0	0	0	TBD	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**

The Air Force/NRO Partnership program provides resources to identify areas for integration of Air Force, NRO, and national space efforts. Better partnering between the Air Force and the NRO will help propel Air Force space leadership into the 21<sup>st</sup> century. Following these investigations, the program resources will be used to conduct joint demonstrations including operations, resources, and space activities, in support of the AF/NRO Integration Planning Group. This PE is in Budget Activity 4 (Demonstration and Validation AKA Program Definition and Risk Reduction) because the nature of the projects will involve testing and demonstrating new cooperative efforts.

The NRO has budgeted an equal amount in FY 1999, reflecting the 50/50 cost sharing ratio established for this program. Both Air Force and NRO will address FY 2000 - 2005 funding to continue this program in their POM - 00 processes.

**(U) Acquisition Strategy:**

FY 1997 (\$ in Thousands):

- (U) \$0 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$0 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$17,645 Conduct joint demonstrations, operations, and space activities in support of the AF/NRO Integration Planning Group.

- (U) \$17,645 Total

Project 4782

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Exhibit R-2 (PE 0603856F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		
4 - Demonstration and Validation			
0603856F Air Force/NRO Partnership (AFNP)			
PROJECT 4782			
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>			
	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) AF/NRO Partnership	0	0	17,645
(U) Total	0	0	17,645
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>			
<u>Performing Organizations:</u>			
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC
		Project Office EAC	Total Prior to FY 1997
		Budget FY 1997	Budget FY 1998
		Budget FY 1999	Budget to Complete
			Total Program
<u>Product Development Organizations</u>			
TBD			
<u>Support and Management Organizations</u>			
TBD			
<u>Test and Evaluation Organizations</u>			
Not Applicable			
<u>Government Furnished Property:</u>			
None			
<u>Subtotal Product Development</u>			
<u>Subtotal Support and Management</u>			
<u>Subtotal Test and Evaluation</u>			
Project 4782			
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Exhibit R-3 (PE 0603856F)			

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY										PE NUMBER AND TITLE	PROJECT
4 - Demonstration and Validation										0603856F Air Force/NRO Partnership (AFNP)	4782
Contractor or											
Government	Method/Type	Award or	Performing	Project	Total	Budget	Budget	Budget	Budget to	Total	
Performing	or Funding	Obligation	Activity	Office	Prior to	FY 1997	FY 1998	FY 1999	Complete	Program	
Activity	Vehicle	Date	EAC	EAC	FY 1997	0	0	17,645	TBD	TBD	
Total Project						0	0	17,645	TBD	TBD	

UNCLASSIFIED

PE NUMBER: 0603860F

UNCLASSIFIED

PE TITLE: Joint Precision Approach and Landing Systems - Dem/Val

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998						
BUDGET ACTIVITY		PE NUMBER AND TITLE				PROJECT				
4 - Demonstration and Validation		0603860F Joint Precision Approach and Landing Systems - Dem/Val				4652				
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
COST (\$ In Thousands)										
4652	Precision Landing Systems	0	0	22,057	16,789	0	0	0	0	38,846
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**  
 This effort will modernize the DoD precision landing architecture by replacing aging ship-board and ground precision landing systems (Instrument Landing System (ILS), Precision Approach Radar (PAR), and Instrument Carrier Landing Systems (ICLS)) which are expected to end their useful life by 2005-2010 and address short-term precision landing deficiencies in the near term. The new Joint Precision Approach and Landing System (JPALS) will be rapidly deployable, operate in adverse weather be day-night survivable and maintainable. JPALS will facilitate DoD mission and training needs by enabling US forces to land on any surface worldwide (land and sea) under peacetime and hostile conditions. This effort may result in modification to avionics in over 6,000 Air Force aircraft and may include a ground segment. This program is in budget activity 4 - Demonstration and Validation, Research Category 6.3B because supportability and manufacturing process design considerations must be identified and integrated into the precision landing architecture.

**(U) Acquisition Strategy:** Demonstration and Validation, multiple contracts, Fixed Price Incentive Fee (FPIF), Firm Fixed Priced contracts (FFP); no Non-Developmental Items (NDI)

(U) FY 1999 (\$ in Thousands):

-	(U) \$3,560	Perform Architecture Definitions
-	(U) \$4,835	Begin aircraft risk reduction studies and integration analyses
-	(U) \$4,965	Begin shipboard risk reduction studies and integration analyses
-	(U) \$8,697	Begin development of Local Area Differential Global Positioning System prototypes/risk reduction
-	(U) \$22,057	Total

Project 4652

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

PE NUMBER AND TITLE

0603860F Joint Precision Approach and Landing

4652

**Total  
Cost**

0/32

4

Exhibit R-2 (PE 0603860F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

0603860F Joint Precision Approach and Landing

4652

Systems - Dem/Val

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Prototype Development	0	0	8,697
(U) Integration Studies and Analyses	0	0	11,488
(U) Systems Engineering/Technical Support	0	0	1,664
(U) Program Management Support	0	0	150
(U) Travel	0	0	58
(U) Total			22,057

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
-------------------------------------------------------	--------------------------------------------------	--------------------------------	-------------------------------	--------------------------	------------------------------	-------------------	-------------------	-------------------	-----------------------	------------------

Product Development Organizations:

TBD	Various	Various	TBD	TBD	0	0	0	15,189	10,073	25,262
<u>Support and Management Organizations</u>										
TBD	Various	Various	TBD	TBD	0	0	0	3,560	3,686	7,246
No contracts more than \$1.0M										
<u>Test and Evaluation Organizations</u>										
TBD			TBD	TBD	0	0	0	3,308	3,030	6,338

Government Furnished Property: N/A

Project 4652

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										
BUDGET ACTIVITY				PE NUMBER AND TITLE				DATE	PROJECT	
4 - Demonstration and Validation				0603860F Joint Precision Approach and Landing				February 1998	4652	
				Systems - Dem/Val						
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total		Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
				Prior to FY 1997						
<u>Product Development Property</u>										
N/A										
<u>Support and Management Property</u>										
N/A										
<u>Test and Evaluation Property</u>										
N/A										
Subtotal Product Development										
						15,189	10,073			25,262
Subtotal Support and Management						3,560	3,686			7,246
Subtotal Test and Evaluation						3,308	3,030			6,338
Total Project						22,057	16,789			38,846

Project 4652

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Exhibit R-3 (PE 0603860F)

Project 4652

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Exhibit R-3 (PE 0603860F)

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PE NUMBER: 0603876F

PE TITLE: Space Based Laser (SBL) (Space)

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**RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)**

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

**4 - Demonstration and Validation****0603876F Space Based Laser (SBL) (Space)**

PROJECT

**4779**

		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	COST (\$ In Thousands)									
4779	Space Based Laser	*0	*0	35,000	35,002	34,994	34,980	34,968	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

\* No FY97 and FY98 Air Force funding, program funded by BMDO (PE0603173C).

**(U) A. Mission Description and Budget Item Justification**

The Space Based Laser (SBL) program was created to provide the nation with a highly effective, continuous, global boost phase intercept option for both theater and national missile defense. An SBL system could defend against missiles without putting the lives of US military personnel at risk. The long range and speed of light defense allows for boost phase intercept at the earliest possible moment, offering the highest probability that intercepted missile fragments will fall within the attackers territory, rather than defended territory. The SBL system could also provide many ancillary mission capabilities, including air defense, global surveillance, and target detection and designation.

BMDO's directed energy program (PE0603173C, Project 1360) has been addressing several key critical program issues, such as the Alpha laser; optics experiments; laser and optics integration; and acquisition, tracking, pointing, and fire control (ATP/FC) tests. Though the major building blocks have been developed, system integration in a space qualified SBL Readiness Demonstrator (SBLRD) vehicle will provide opportunities for more complete ground and flight testing. The SBLRD is the first step in proving the feasibility and operational contribution of killing ballistic missiles in their boost phase from orbit. The SBLRD could also demonstrate potential contributions to other Air Force missions. This PE is in Budget Activity 4 (Demonstration and Validation) because it is performing Program Definition and Risk Reduction activities in support of SBLRD development.

**Acquisition Strategy:** The Air Force is the program's executing agent. BMDO and Air Force are jointly funding the SBLRD development activities. SBLRD development contract award planned for 4QFY98.

(U) FY 1997 (\$ in Thousands):

- (U) \$0 Total

(U) FY 1998 (\$ in Thousands):

- (U) \$0 Total

Project 4779

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Exhibit R-2 (PE 0603876F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603876F Space Based Laser (SBL) (Space)

4779

## (U) FY 1999 (\$ in Thousands):

- (U) \$15,000 Design, development, and integration of laser payload element

- (U) \$15,000 Design, development and integration of optical payload element

- (U) \$ 5,000 Design, development and integration of spacecraft element

- (U)

- (U)

- (U) \$35,000 Total

\* Continue FY98 activities funded by BMDO (PE0603173C).

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	0	0	0	0
(U) Appropriated Value				
(U) Adjustments to Appropriated Value				
a. Cong Reductions				
b. SBIR				
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
(U) Adjustments to Budget Years Since FY 1998 PB			35,000	
(U) Current Budget Submit (FY 1999 President's Budget)	0	0	35,000	Cont

## (U) Change Summary Explanation:

Funding: Air Force SBLRD development funding starts in FY99.

Schedule: None.

Technical: None.

Project 4779

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation

0603876F Space Based Laser (SBL) (Space)

4779

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) BMDO, PE0603173C (Project 1360)	93,846	122,010	58,813	58,635	58,367	58,181	57,911	Cont	Cont

(U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1	2	3	4	1	2	3	4

(U) SBL Readiness Demonstrator Contract Award

(U) Readiness Demonstrator Segments Detailed Definition/Development to prepare for PDR

(U) Component Development/Risk Reduction\*

(U) High Altitude Flight Test of ATP Component Technology\*

\* BMDO (PE0603173C) FY99 schedule profile.

Project 4779

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603876F Space Based Laser (SBL) (Space)

4779

### (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
Design, development, and integration of laser payload element	0	0	15,000
Design, development and integration of optical payload element	0	0	15,000
Design, development and integration of spacecraft element	0	0	5,000

(U) Total \*

0	0	35,000
---	---	--------

\* No FY97 and FY98 Air Force (Program funded by BMDO).

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget			Total Program
						FY 1997	FY 1998	FY 1999	
TBD	C/CPAF	4Q98	TBD	TBD	0	0	0	35,000	TBD

#### Product Development Organizations

Support and Management Organizations  
Not Applicable.

Test and Evaluation Organizations  
Not Applicable.

Project 4779

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Exhibit R-3 (PE 0603876F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0603876F Space Based Laser (SBL) (Space)

4779

(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)Government Furnished Property:  
None.Subtotal Product Development  
Subtotal Support and Management  
Subtotal Test and Evaluation

35,000

TBD

TBD

Total Project

0

35,000

TBD

TBD

NOTE: No FY97 and FY98 Air Force funding (Program funded by BMDO).

Project 4779

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Exhibit R-3 (PE 0603876F)

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PE NUMBER: 0604237F

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PE TITLE: Variable Stability In-Flight Simulation Test Aircraft

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0604237F Variable Stability In-Flight Simulation Test Aircraft								3308	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3308	Variable Stability In-Flight Simulation Test Aircraft	1,336	5,650	0	0	0	0	0	0	59,508	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

(U) A. Mission Description and Budget Item Justification: This demonstration and validation program modifies an F-16D to create a versatile high-performance flying simulator to replace the NT-33A aircraft, which retired in May 1997. For the past 39 years, the research and development flight test community extensively employed the variable stability NT-33A for flight evaluation of fielded aircraft upgrades and new aircraft developments. Its success has been directly attributable to its relatively low-cost of operation, rapid response to customer needs, and high degree of credibility in the flight test community. VISTA was developed to replace the NT-33A because the NT-33A's performance was not representative of future aircraft (it was the oldest aircraft in the Air Force still actively flying). VISTA has the capability to simulate a wide range of air vehicles to verify crucial flight control and human factor designs, establish flying qualities specification criteria, and operate as a flying laboratory for flight control and cockpit display research. In addition, the Air Force Test Pilot School has used VISTA, as they have the NT-33A, to safely train test pilots to evaluate aircraft handling quality, avionics, and human factors designs in a realistic high-performance environment. Future costs to operate VISTA will be funded by PE 0603245F, Flight Vehicle Integration, and other users' aircraft development and training programs. There are no plans to request future funding in this PE to continue operating the VISTA aircraft.

(U) FY 1997 (\$ in Thousands):

- (U) \$1,336	Upgrade VISTA to permit continued investigation of the flight control laws and performance characteristics of fielded aircraft upgrades, new aircraft developments, and test pilot training.
- (U) \$1,336	Upgraded mechanical and electrical aircraft subsystems, reassembled the aircraft, and checked out modifications to ensure safety of flight on subsequent flight testing and training.
- (U) \$1,336	Total

Project 3308

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Exhibit R-2 (PE 0604237F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
4 - Demonstration and Validation	0604237F Variable Stability In-Flight Simulation Test Aircraft	3308	
<p>(U) FY 1998 (\$ in Thousands):</p> <ul style="list-style-type: none"><li>- (U) \$5,650 Continue to upgrade VISTA to permit continued investigation of flight control laws and performance characteristics of fielded aircraft upgrades, new aircraft developments, and test pilot training.</li><li>- (U) Continue upgrade program to provide electrical and mechanical interfaces for future installation of an F100-PW-299 engine with an existing axisymmetric thrust vectoring nozzle and a programmable display subsystem.</li></ul> <p style="text-align: right;">Total</p> <p>(U) FY 1999 (\$ in Thousands):</p> <p style="text-align: right;">- (U) 0 Total</p>			

Project 3308

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Exhibit R-2 (PE 0604237F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0604237F Variable Stability In-Flight Simulation

3308

Test Aircraft

(U) B. Program Change Summary (\$ in Thousands):

(U) Previous President's Budget (FY 1998 PB)	FY 1997	FY 1998	FY 1999	Total
(U) Appropriated Value	1,338	0	0	Cost
(U) Adjustments to Appropriated Value	1,400	6,000		0
a. Congressional/General Reductions	-31	-196		
b. SBIR	-33	-154		
c. Omnibus/Other Above Threshold Reprogrammings				
d. Below Threshold Reprogrammings	-2			
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB				
(U) Current Budget Submit/FY 1999 President's PB	1,336	5,650	0	59,508

## (U) Change Summary Explanation:

Funding: In FY 1996, the VISTA upgrade program was funded under PE 0603245F, Flight Vehicle Technology Integration, and by other reimbursable customers. In FY 1997 and FY 1998, Congress added funds to PE 0604237F to continue the VISTA upgrade program. VISTA will continue flight testing in FY 1999 and beyond, but will be funded from PE 0603245F and other aircraft test and training programs. There are no plans to request future funding in this PE to continue the VISTA program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602201F, Aerospace Flight Dynamics.
- (U) PE 0603245F, Flight Vehicle Technology Integration.
- (U) This project has been coordinated through the Project Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

Project 3308

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Exhibit R-2 (PE 0604237F)

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PE NUMBER: 0604327F

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PE TITLE: Hardened Target Munitions

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
4 - Demonstration and Validation		0604327F Hardened Target Munitions								4641	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4641 (U) Hard and Deeply Buried Target Defeat System		0	4,981	0	0	0	0	0	0	0	4,981
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

The Hard and Deeply Buried Target Defeat Capability (HDBTDC) program is an effort designed to hold at risk those highest priority assets essential to the enemy's war fighting ability, which are heavily defended and protectively hardened. Hardening techniques include construction of facilities, of which many are deep underground, with multiple layers of reinforced concrete, rock rubble, and/or earth overburden. Other hardened targets include operations within caves, tunnels, and mountains, built using rapidly improving construction equipment, exported by allies and adversaries on a large scale. (Examples include enemy command and control facilities, air defense facilities, facilities for the production, storage, and deployment of weapons including weapons of mass destruction, surface to surface missile launch sites, aircraft storage, artillery sites, etc.) HDBTDC is currently in the Concept Exploration phase, potential solutions include (but are not limited to) Special Forces, conventional short or long range ballistic missiles (land or sea launched), cruise missiles, direct attack munitions, standoff weapons, etc. FY98 funds will complete the Phase 0 Analysis of Alternatives (AOA) study effort, augment ongoing sensitivity and trade studies activity, prepare for System Program Office standup (acquisition support and documentation), and initiate preliminary Phase I Program Definition and Risk Reduction (PDRR) activities. FY 96 and FY 97 Phase 0 (Concept Exploration) Analysis of Alternatives (AOA) expenditures were accomplished in PE 0603311F (Ballistic Missile Technology). This program is in budget activity 4 - Demonstration and Validation, because the prototyping, demonstration, and early operational assessment (risk reduction strategies) associated with technology, manufacturing, and support of several conceptual systems under consideration will occur in FY 98. Formal commencement of Phase I (PDRR) activity will occur early in the first quarter of FY 99.

**(U) Acquisition Strategy:**

The strategy to accomplish the Phase 0 AOA work was agreed upon by the AOA Study Directors (Headquarters Air Force Space Command and Headquarters Air Combat Command) via the Integrated Product Team (IPT) process. The contract to perform the Phase 0 AOA work is a modification to an existing Systems Engineering and Technical Assistance (SETA) support contract to the Ogden Air Logistics Center (OO-ALC) ICBM System Program Office (SPO) - a Cost Plus Award Fee (CPAF) contract filled by TRW (Colorado Springs). The ICBM SETA support contract is specifically constructed to address space force applications. TRW was instructed (by the IPT) to enlist the unique expertise required for aircraft and cruise missile delivered options, hence subcontracts by TRW to Veda Inc. (Dayton Ohio) and ARA Inc. (Applied Research Associates - Albuquerque NM). The original SETA contract was competed LAW all applicable federal guidelines. Hardened Target Munitions Program is not adequately defined at this time. Preliminary acquisition strategy anticipates a 36 month PDRR.

Project 4641

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

4 - Demonstration and Validation 0604327F Hardened Target Munitions 4641

(U) FY 1997 (\$ in Thousands):

— (U) \$0  
 — (U) \$0  
 — (U) \$0 Total

(U) FY 1998 (\$ in Thousands):

— (U) \$1,820 Complete Analysis of Alternatives (AOA) study effort.  
 — (U) \$2,012 Commence System Program Office(s) (SPO) Standup  
 — (U) \$ 884 Commence Preliminary Program Definition and Risk Reduction (PDRR) Activities (Phase I)  
 — (U) \$4,716 Total

(U) FY 1999 (\$ in Thousands):

— (U) \$2,012 Continue System Program Office(s) support  
 — (U) \$2,921 PDRR Activity - Conduct Systems Requirements Reviews (SRR)  
 — (U) \$4,870 PDRR Activity - Conduct Preliminary Design Reviews (PDR)  
 — (U) \$9,803 Total

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget	0	0	0	0
(U) Appropriated Value	0	4,981	0	0
(U) Adjustments to Appropriated Value				
a. Cong Reductions		- 163		
b. SBIR		- 102		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming	0			
(U) Adjustments to Budget Years Since FY 1998 PB		0	9,803	
(U) Current Budget Submit/FY 1999 President's Budget	0	4,716	9,803	14,519

Project 4641

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 4 - Demonstration and Validation

0604327F Hardened Target Munitions

4641

## (U) Change Summary Explanation:

Funding: FY 98 funding is required to complete the Phase 0 Analysis of Alternatives (AOA) and transition the program from Concept Exploration (Phase 0) to Program Definition and Risk Reduction (Phase I), depending on the results of the AOA. FY 99 funds added for program continuation. FY 00 and follow-on funding to be addressed in the FY 00-05 POM process.

Schedule: None

Technical: None

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) PE 0603311 Ballistic Missile Technology	\$600	0	0	0	0	0	0	0	3,800*
(U) Total	\$600	0	0	0	0	0	0	0	3,800*

NOTES: \* \$3200 in FY96 RDT&E was executed in PE 0603311F (Ballistic Missile Technology) because the AOA was a pre-Milestone I effort.

(U) D. Schedule Profile

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) Commence Formal AOA	X*											
(U) Complete AOA									X			
(U) Commence Program Office(s) (SPO) Standup												
(U) Milestone I; Commence PDRR									X			
(U) Conduct System Requirements Review (SRR)										X		
(U) Start Preliminary Design										X		
(U) Conduct Preliminary Design Review (PDR)											X	

NOTE: \* Accomplished (executed) in PE 0603311F (Ballistic Missile Technology)

Project 4641

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Exhibit R-2 (PE 0604327F)

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT		
4 - Demonstration and Validation		0604327F Hardened Target Munitions								4641		
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>												

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

4 - Demonstration and Validation 0604327F Hardened Target Munitions

PROJECT

4641

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget FY 2000	Budget to Complete	Total Program
ASC/YG (Eglin)	CPAF	Oct 97	N/A	N/A	0	0	1,006	1,006	0	0	2,012
SMC/TE (Kirtland)	CPAF	Oct 97	N/A	N/A	0	0	1,006	1,006	0	0	2,012
<u>Test and Evaluation Organizations : None</u>											
<u>Government Furnished Property: None</u>											
(U) Subtotal Product Development					0	0	2,704	7,791	0	0	10,495
(U) Subtotal Support and Management					0	0	2,012	2,012	0	0	4,024
(U) Subtotal Test and Evaluation					0	0	0	0	0	0	0
(U) Total Project					0	0	4,716	9,803	0	0	14,519

Project 4641

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Exhibit R-3 (PE 0604327F)

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PE NUMBER: 0305176F

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PE TITLE: Combat Survivor Evader Locator (CSEL)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0305176F Combat Survivor Evader Locator (CSEL)								4522	
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4522	CSAR EMD	13003	3994	0	0	0	0	0	0	34,496	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	
<p>Note: Funds for this PE in FY97 and prior were in Budget Activity 3 - Demonstration and Validation.</p> <p>(U) <b>A. Mission Description and Budget Item Justification</b></p> <p>(U) The Combat Survivor/Evader Locator (CSEL) is a joint program, with the Air Force as lead Service, that will provide enhanced Combat Search and Rescue (CSAR) capability by replacing antiquated survivor radios (PRC-90/112) with current and emerging technologies in a new end-to-end system. The CSEL system will be used by all the Services and DoD, and potentially non-DoD government agencies. CSEL system features include a new radio which incorporates two-way, secure over-the-horizon (OTH) messaging, line-of-sight (LOS) voice, near real-time ge positioning, verification of evader identity and condition, low probability of intercept/detection (LPI/LPD), anti-jam, and the potential integration of commercial satellite systems capabilities. This program is in Budget Activity (BA) 5, Engineering and Manufacturing Development (EMD) because it is in engineering and manufacturing development and has not received full-rate production approval.</p> <p>(U) <b>Acquisition Strategy:</b></p> <p>All major contracts within this Program Element were awarded after full and open competition.</p> <p>(U) <u>FY 1997</u></p> <p>- (U) \$ 7,518 CSEL Engineering and Manufacturing Development</p> <p>- (U) \$ 2,000 COBRA Base Station Development</p> <p>- (U) \$ 3,485 Other Government Support</p> <p>- (U) \$13,003 Total</p> <p>(U) <u>FY 1998</u></p> <p>- (U) \$ 2,546 CSEL Engineering and Manufacturing Development</p> <p>- (U) \$ 1,448 Other Government Support</p> <p>- (U) \$ 3,994 Total</p> <p>(U) <u>FY 1999</u></p> <p>- (U) \$ 0 Not Applicable</p>											

Project 4522

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Exhibit R-2 (PE 0305176F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0305176F Combat Survivor Evader Locator (CSEL)

4522

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY1998 PB)	9,218	4,315	0	27,033
(U) Appropriated Value	9,596			
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-201	-262		
b. SBIR	-177	-59		
c. Omnibus and Other Above Threshold Reprogram	*			
d. Below Threshold Reprogramming	**3,800	***		
e. Rescission	-15			
(U) Adjustments to Budget Years since FY1998 PB	13,003	3,994	0	34,496
(U) Current Budget Submit (FY1999 President's Budget)				

## (U) Change Summary Explanation:

Funding: \* \$4,600 FY97 Omnibus processed, but not yet reflected in funding database. Funding is for UHF/VHF module manufacturing problems and UHF SATCOM Demand Assigned Multiple Access (DAMA)  
 \*\* \$3,800 FY97 BTR to initiate efforts to comply with JCS requirements for DAMA compatibility.  
 \*\*\* \$3,999 FY98 BTR processed, but not yet reflected in funding database. Funding is to initiate Defense Information Infrastructure Common Operating Environment (DII COE) development effort for interoperability among Services.

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl Continue	Total Cost Continue
(U) Other Procurement, Air Force (PE 0305176F) (BA 63, P-70)	2,858	5,599	13,757	14,512	14,327	5,866	6,007		

(U) RELATED ACTIVITIES: None

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Exhibit R-2 (PE 0305176F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0305176F Combat Survivor Evader Locator (CSEL)

4522

(U) D. Schedule Profile

	FY 1997		FY 1998		FY 1999			
	1	2	3	4	1	2	3	4
(U) Final Design Review	X							
(U) Production Options Proposal				X				
(U) Production Option 1 Award (OPAF)				X				
(U) Government DT/OA					X			
(U) Option 1 (First Unit) Delivery								
(U) Production Option 2 Award (OPAF)						X		
(U) Option 2 (First Unit) Delivery						X		
(U) IOT&E Start								
(U) Production Option 3 Award (OPAF)								X
(U) Option 3 Delivery (2nd Qtr FY00)								

Project 4522

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Exhibit R-2 (PE 0305176F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0305176F Combat Survivor Evader Locator (CSEL)

4522

(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) CSEL Engineering and Manufacturing Development	*7,518	**2,546	0
(U) COBRA Base Station Development	2,000	0	0
(U) Other Government Support	3,485	1,448	0
(U) Total	13,003	3,994	0

\* Does not include the FY97 OMNIBUS \$4,600 for CSEL EMD not yet reflected in the funding database

\*\* Does not include the FY98 BTR \$3,999 for CSEL EMD not yet reflected in the funding database

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or

Government

Performing

Activity

Method/Type or

Funding Vehicle

Award or

Obligation

Date

Performing

Activity

EAC

Total

Prior to

FY 1997

Budget

FY 1997

FY 1998

FY 1999

Total

Program

Product Development Organizations

Boeing

CPAF

Multiple

Multiple

23 Feb 96

49,458

4,000

4,000

14,962

9,975

3,864

0

0

25,026

4,000

Support and Management Organizations

Program Support

Test and Evaluation Organizations

AFOTEC

54

250

3,808

0

0

4,916

554

34,496

7,922\*\*

0

Government Furnished Property: Not Applicable.

Subtotal Product Development

Subtotal Support and Management

Subtotal Test and Evaluation

Total Project

\* Includes the \$4,600 FY97 OMNIBUS not yet reflected in the funding database.

\*\* Includes the \$3,999 FY98 BTR not yet reflected in the funding database.

Project 4522

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Exhibit R-3 (PE 0305176F)

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PE NUMBER: 0604201F

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PE TITLE: Integrated Avionics Planning and Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604201F Integrated Avionics Planning and Development									
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
COST (\$ In Thousands)											
Total Program Element (PE) Cost		14,202	15,406	10,762	3,760	2,081	3,011	3,037	0	81,039	
2257 Standard Avionics & JSRC Initiatives		929	1,415	721	736	731	0	0	0	19,896	
2258 Standard Inertial Navigation Unit		470	255	0	0	0	0	0	0	3,353	
2050 Joint Helmet-Mounted Cueing System (JHMCS)		12,803	13,736	10,041	3,024	1,350	3,011	3,037	0	56,402*	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	
* Total Air Force Cost											
<p>(U) <u>A. Mission Description and Budget Item Justification</u></p> <p>This program element explores and develops integrated avionics architectures and components which will reduce acquisition and support costs, increase weapon system performance and availability, and foster weapons system interoperability with standard interfaces. This program element is devoted to the demonstration and Engineering and Manufacturing Development (EMD) of integrated avionics architectures and open systems. The scope is both domestic and international. Reliability and Maintainability (R&amp;M) and deployment footprint play a major role in the identification of specific development efforts within this element. Joint avionics development efforts are pursued through participation in and support of the Joint Service Review Committee (JSRC). Current initiatives include the Embedded Global Positioning System/Inertial Navigation System and the Joint Helmet-Mounted Cueing System. This is budget activity 5 due to the development nature of the effort.</p> <p>(U) <u>Acquisition Strategy:</u></p> <p>Acquisition strategy is incorporated at the project level.</p>											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

## 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE

## 0604201F Integrated Avionics Planning and Development

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY98 PB)	17,726	16,494	7,884	81,744
(U) Appropriated Value	18,620	16,494		
(U) Adjustments to Appropriated Value				
a. Congressional / General Reductions	-410	-681		
b. SBIR	-484	-407	**	
c. Omnibus or Above Threshold Reprogramming		*		
d. Below Threshold Reprogramming	-3,495			
e. Rescission	-29			
(U) Adjustment to Budget Year since FY98 PB			2,878	
(U) Current Budget Submit/FY 1999 President's Budget	14,202	15,406	10,762	79,543

## (U) Change Summary Explanation:

Funding: FY97: Below Threshold Reprogramming action was to move funds to the F-15 program (PE 0207134F) with equivalent payback in FY99. This was to match work in the out years that was moved because of a 4 month delay in contract initiation.

FY98: \*\$106,000 is pending reprogramming to fund higher priorities; \*\*\$2,000 is pending for an additional SBIR reduction.

FY99: Increase of \$2,878,000 includes: a \$3,495,000 Zero Baseline Transfer (ZBT) from the F-15 program (PE 0207134F) to BPAC 2050 (reference payback from FY97), decrease of \$217,000 for an economic adjustment, and termination of a subtask (Level of Effort) from BPAC 2257 of \$400,000 for higher AF priorities.

Schedule: No changes

Technical: No changes

(U) C. Other Program Funding Summary (\$ in Thousands) Not Applicable(U) D. Schedule Profile See individual projects

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604201F Integrated Avionics Planning and Development								2257	
		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
	COST (\$ In Thousands)										
2257	Standard Avionics & JSRC Initiatives	929	1,415	721	736	731	0	0	0	19,896	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**  
 This project identifies, demonstrates and/or develops candidate architecture standards and open system modular components for the Air Force and other services. Maintains/updates the common avionics database as a widely used avionics interoperability/standardization planning tool. Supports international avionics initiatives and standardization activities such as Global Air Traffic Management (GATM) Integrated Product Team. Develops an opportunity matrix for tactical and airlift programs to identify opportunities to leverage investments for aging avionics, parts obsolescence and avionics modernization. Common Avionics Modernization Planning is a Phase 0 (concept exploration) project that explores candidate avionics systems and designs for potential developmental efforts and aircraft interoperability initiatives. The Joint Service Review Committee (JSRC) coordinates avionics standardization projects between the Air Force, Army and Navy. This program is in budget activity 5 because of the development nature of the effort.

**(U) Acquisition Strategy:** These projects are in acquisition Phase 0 (concept exploration) and are accomplished through various prime contractors or Assistance & Advisory Support (A & AS) contracts. They are awarded competitively, and follow the most recent DoD acquisition guidelines using the integrated product development philosophy.

Project 2257

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Exhibit R-2 (PE 0604201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		PROJECT	
5 - Engineering and Manufacturing Development	0604201F Integrated Avionics Planning and Development		2257	
(U) FY 1997				
- (U) \$	180	Continued Tri-Service Standardization / Joint Service Review Committee (JSRC) - Avionics Standardization (AS)		
- (U) \$	265	Continued Horizontal Avionics Modernization Planning (HAMP)		
- (U) \$	165	Continued Avionics Planning Baseline		
- (U) \$	35	Continued Logistics/ Initiative Planning & Support		
- (U) \$	284	Continued Program Management Support		
- (U) \$	929	Total		
(U) FY 1998				
- (U) \$	25	Continue Tri-Service Standardization / Joint Service Review Committee (JSRC) - Avionics Standardization (AS)		
- (U) \$	265	Continue Horizontal Avionics Modernization Planning (HAMP)		
- (U) \$	275	Continue Avionics Planning Baseline		
- (U) \$	600	Complete Logistics/ Initiative Planning & Support		
- (U) \$	169	Conduct B-52 Steerable Television Evaluation		
- (U) \$	81	Continue Program Management Support		
- (U) \$	1,415	Total		
(U) FY 1999				
- (U) \$	25	Continue Tri-Service Standardization / Joint Service Review Committee (JSRC) - Avionics Standardization (AS)		
- (U) \$	265	Continue Horizontal Avionics Modernization Planning (HAMP)		
- (U) \$	175	Continue Avionics Planning Baseline		
- (U) \$	256	Continue Program Management Support		
- (U) \$	721	Total		

Project 2257

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Exhibit R-2 (PE 0604201F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and

2257

Development

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 98)	964	1,594	1,135	20,563
(U) Appropriated Value	1,013			
(U) Adjustments to Appropriated Value				
a. Congressional / General Reduction	-23	-142		
b. SBIR	-26	-37		
c. Omnibus or Above Threshold Reprogramming				
d. Below Threshold Reprogramming	-35	*		
e. Rescission				
(U) Adjustment to Budget since FY98 PB			-414	
(U) Current Budget Submit/FY 1999 President's Budget	929	1,415	721	19,896

## (U) Change Summary Explanation:

Funding: FY97: \$35,000 reallocated from BPAC 2257 to BPAC 2258. FY98: \*\$10,000 is pending reprogramming to fund higher priorities. FY99: reduction is for higher AF priorities (\$400,000) and an economic adjustment (\$14,000).

Schedule: No changes

Technical: No changes

(U) C. Other Program Funding Summary (\$ in Thousands) Not Applicable

Project 2257

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Exhibit R-2 (PE 0604201F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604201F Integrated Avionics Planning and Development	2257	
<u>(U) D. Schedule Profile</u>			
		FY 1997	FY 1998
		1 2 3	1 2 3 4
(U) Tri-Service Standardization			1 X
(U) HAMP			X X
(U) Publish Avionics Planning Baseline			X X
(U) B-52 Steerable Television Evaluation			X
X - Planned Effort			
* - Completed Effort			

Project 2257

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Exhibit R-2 (PE 0604201F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2257

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Tri-Service standardization via JSRC	180	25	25
(U) HAMP	265	265	265
(U) Avionics Planning Baseline	165	275	175
(U) Logistics / Initiative Planning and Support	35	600	0
(U) B-52 Steerable Television Evaluation	0	71	0
(U) Program Management Support	284	179	256
(U) Total	929	1,415	721

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands):

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program

Product Development Organizations: NoneSupport and Management Organizations:

Support Contracts	HFP	Annual 1 Jan	15,423	15,423	12,291	606	1,108	465	953	15,423
Prgm Mgmt Support	Various	Annual 1 Jan	4,473	4,473	3,073	323	307	256	514	4,473

Test and Evaluation Organizations NoneGovernment Furnished Property: None

Project 2257

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Exhibit R-3 (PE 0604201F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

PROJECT

2257

0604201F Integrated Avionics Planning and Development

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development			0	0	0	0	0	0	0	0
Subtotal Support and Management			19,896	19,896	15,364	929	1,415	721	1,467	19,896
Subtotal Test and Evaluation			0	0	0	0	0	0	0	0
Total Project			19,896	19,896	15,364	929	1,415	721	1,467	19,896

Project 2257

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2258

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2258 Standard Inertial Navigation Unit	470	255	0	0	0	0	0	0	3,353
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

Develop DoD standard Embedded Global Positioning System (GPS)/ Inertial Navigation System (INS) (EGI) Precise Positioning System (PPS), (0.8 nm/h free inertial) Navigation System for Army's OH-58 Kiowa Warrior, Army Special Operations Helicopters, Apache AH-64A+ and AH-64 C/D Apache Longbow helicopters, Navy's AH-1W Super Cobra helicopter, F-14, F-18, EA-6B, and S-3 and Air Force A-10, F-15, F-16 and KC-135 aircraft and additional weapon systems as identified. Directly tied to the Congressionally mandated Minimum Avionics Requirement (MAR) capability for DoD aircraft and the Joint Chiefs of Staff (JCS) Radio Navigation Master Plan. Develop enhanced accuracy (0.3 nm/hr) Inertial Navigation Unit (INU) for the F-117A aircraft. Continue development of INU depot Support Equipment (SE) for the Standard Ring Laser Gyro (RLG) program Embedded GPS/INS efforts resulted from a tri-service acquisition plan. Program currently is in phase III (Production). Contracts were awarded on a full and open basis to Honeywell and Litton Industries. This program is in budget activity 5 because of the development nature of the effort.

**(U) Acquisition Strategy:** This program uses two suppliers which compete for future platform missionization and production using a competitive down select process. The two contracts are written with identical terms and conditions to facilitate the downselect process. Contract will be restructured to continue EGI acquisition upgrades from FY 99 through FY 03 to accommodate platforms which are not yet in compliance with the Congressional mandate. The delivery orders are managed in a government-contractor IPT environment with tri-service participation by the Air Force, Navy, and Army.

Project 2258

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<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
5 - Engineering and Manufacturing Development		0604201F Integrated Avionics Planning and Development	2258

  

(U)	FY 1997 (\$ in Thousands)	
-	(U) \$ 145	Continued Engineering Tasks
-	(U) \$ 325	Continued Program Management Support
-	(U) \$ 470	Total
(U)	FY 1998 (\$ in Thousands)	
-	(U) \$ 99	Complete Engineering Tasks
-	(U) \$ 156	Complete Program Management Support
-	(U) \$ 255	Total
(U)	FY 1999 (\$ in Thousands)	
-	(U) \$ 0	Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
5 - Engineering and Manufacturing Development	0604201F Integrated Avionics Planning and Development	February 1998	2258
(U) B. <u>Program Change Summary (\$ in Thousands)</u>			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY 98)	435	299	0
(U) Appropriated Value	459	299	
(U) Adjustments to Appropriated Value			
a. Congressional / General Reductions	-12	-37	
b. SBIR	-12	-7	
c. Omnibus or Above Threshold Reprogramming		*	
d. Below Threshold Reprogramming	35		
e. Rescission			
(U) Adjustment to Budget Years since FY98 PB			0
(U) Current Budget Submit/FY 1999 PB	470	255	0
			3,353
			Total Cost 3,362
(U) Change Summary Explanation:			
Funding: FY'97: \$35,000 reallocated to BPAC 2258 from BPAC 2257. FY 98: *\$2,000 is pending reprogramming to fund higher priorities.			
Schedule: No changes			
Technical: No changes			

Project 2258

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Exhibit R-2 (PE 0604201F)

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2258

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Engineering Tasks	145	99	0
(U) Program Management Support	325	156	0
(U) Total	470	255	0

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	FY 1999	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>											
Honeywell	FFP/LOE	9/96	110	110	110						110
Litton	FFP/LOE	1/97	10	10	10						10
SA-ALC	MIPR	7/97	50	50	50						50
<u>Support and Management Organizations</u>											
Mission Support	LOE		3,183	3,183	2,458	470	255	0	0	0	3,183
<u>Test and Evaluation Organizations: None</u>											
<u>Government Furnished Property: None</u>											
Subtotal Product Development			170	170	170	0	0	0	0	0	170
Subtotal Support and Management			3,183	3,183	2,458	470	255	0	0	0	3,183
Subtotal Test and Evaluation			0	0	0	0	0	0	0	0	0
Total Project			3,353	3,353	2,628	470	255	0	0	0	3,353

Project 2258

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2050

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2050 Joint Helmet-Mounted Cueing System (JHMCS)	12,803	13,736	10,041	3,024	1,350	3,011	3,037	0	56,402*
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

\* Total Air Force Cost

(U) A. Mission Description and Budget Item Justification

This Joint program with the USN will develop a helmet display system, capable of depicting aircraft heading data, pilot's viewing perspective, target indication graphics and digital information. Consolidating this information on the pilot's visor allows the pilot to quickly align sensors and weapons on targets and engage threats using high off-boresight angle weapons such as the AIM-9X. The JHMCS includes a helmet with a mounted visor display capability, a helmet-vehicle interface cable, and several other components. JHMCS is currently in Phase II, Engineering & Manufacturing Development (EMD). This program is in budget activity 5 because of the development nature of the effort.

(U) Acquisition Strategy: The Joint Helmet Mounted Cueing System (JHMCS) is an ACAT III joint USAF/USN program (USAF - executive service) currently in EMD. The contract structure is a Cost Plus Award Fee (CPAF) contract awarded in a competitive source selection environment. Our CPAF contract is through Boeing - St. Louis for integration into the F-15 and F/A-18. Lockheed Martin will be responsible for platform integration into the F-16 and F-22. Boeing has subcontracted to Vision Systems International (VSI) to provide JHMCS subsystems hardware/software. VSI is a company which is a partnership between Elbit (an Israeli company based in Ft Worth, TX) and Kaiser Electronics. The Joint Program Office is using a unique approach of developing common hardware as Contractor Furnished Equipment (CFE) to minimize platform integration risk. The next major program milestone is first flight in Oct 98.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2050

(U) FY 1997		
- (U) \$ 11,216	Continued Joint Helmet Mounted Cueing System (JHMCS) EMD contract.	
- (U) \$ 761	Conducted Risk Reduction (MDA, LMTAS, & Lab Technology)	
- (U) \$ 397	Continued Test Support (AFFTC)	
- (U) \$ 429	Continued Program Management Support	
- (U) \$ 12,803	Total	
(U) FY 1998		
- (U) \$ 10,786	Continue Joint Helmet Mounted Cueing System (JHMCS) EMD contract.	
- (U) \$ 600	Continue Risk Reduction (LMTAS)	
- (U) \$ 1,666	Continue Test Support (AFFTC)	
- (U) \$ 684	Continue Program Management Support	
- (U) \$ 13,736	Total	
(U) FY 1999		
- (U) \$ 7,186	Continue Joint Helmet Mounted Cueing System (JHMCS) EMD contract.	
- (U) \$ 2,255	Continue Test Support (AFFTC)	
- (U) \$ 600	Continue Program Management Support	
- (U) \$ 10,041	Total	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

PROJECT

2050

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY98PB)	16,327	14,601	6,749	57,819
(U) Appropriated Value	17,148	14,601		
(U) Adjustments to Appropriated Value				
a. Congressional / General Reductions	-375	-502		
b. SBIR	-446	-363	**	
c. Omnibus or Above Threshold Reprogramming		*		
d. Below Threshold Reprogramming	-3,495			
e. Rescission	-29			
(U) Adjustments to Budget Years since FY98PB			3,292	
(U) Current Budget Submit/FY 1999 President's Budget	12,803	13,736	10,041	56,402

## (U) Change Summary Explanation:

Funding: FY 97: Below Threshold Reprogramming (BTR) was in response to a late contract award generating the need to reprogram funds with equivalent pay-back in the outyears. AFPEO/FB directed the BTR action of funds (\$3,495,000) to support F-15E Squadrons Operational System Development.

FY 98: \*\$94,000 is pending reprogramming to fund higher priorities, \*\*\$2,000 pending for additional SBIR reduction.

FY 99: Increase by \$3,292,000 includes: a \$3,495,000 Zero Baseline Transfer (ZBT) from the F-15 program (PE 0207134F) and decrease of \$203,000 for an economic adjustment.

Schedule: This contract slippage resulted in a schedule shift of four months.

Technical: No Changes

(U) C. Other Program Funding Summary (\$ in Thousands) Not Applicable

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# RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE

0604201F Integrated Avionics Planning and Development

PROJECT

2050

(U) D. Schedule Profile

	<u>FY 1997</u>			<u>FY 1998</u>			<u>FY 1999</u>				
1	2	3	4	1	2	3	4	1	2	3	4
(U) Milestone II (EMD Contract Award)											
(U) Critical Design Review	*										
(U) System Integration Testing			*		X						
(U) Flight Test								X			
(U) Functional Configuration Audit										X	

X - Planned Effort

\* - Completed Effort

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
5 - Engineering and Manufacturing Development	0604201F Integrated Avionics Planning and Development	February 1998	2050
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>			
		<u>FY 1997</u>	<u>FY 1998</u>
(U) EMD Effort		11,216	10,786
(U) Risk Reduction Tasks		761	600
(U) Test Support (AFFTC)		397	1,666
(U) Program Management Support		429	684
(U) Total		12,803	13,736
			<u>FY 1999</u>
			7,186
			0
			2,255
			600
			10,041

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604201F Integrated Avionics Planning and Development

2050

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands):

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
<b>Product Development Organizations</b>										
MDA/LMTAS	CPAF	2/97	43,856	43,856	6,863	11,216	10,786	7,186	7,805	43,856
<b>Support and Management Organizations</b>										
Various	Various	2/97	8,132	8,132	2,521	1,210	1,284	600	2,517	8,132
<b>Test and Evaluation Organizations:</b>										
Various	Various	2/97	4,414	4,414	16	377	1,666	2,255	100	4,414
<b>Government Furnished Property: None</b>										
<b>Subtotal Product Development</b>										
			43,856	43,856	6,863	11,216	10,786	7,186	7,805	43,856
<b>Subtotal Support and Management</b>			8,132	8,132	2,521	1,210	1,284	600	2,517	8,132
<b>Subtotal Test and Evaluation</b>			4,414	4,414	16	377	1,666	2,255	100	4,414
<b>Total Project</b>			56,402	56,402	9,400	12,803	13,736	10,041	10,422	56,402

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PE NUMBER: 0604218F

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PE TITLE: Engine Model Derivative Program (EMDP)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604218F Engine Model Derivative Program (EMDP)								2634	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
2634	Engine Model Derivative Program (EMDP)	1,474	701	0	0	0	0	0	0	10,584	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**

EMDP is an engineering development level of effort program that provides the latest engine technology advances to current weapon systems and provides a framework for engine development for future systems. EMDP contributes to system life extension, reduced life cycle cost, and enhanced performance. Enhanced performance is required to counter increases in system weight and increased threat capability. EMDP demonstrates derivative engine concepts incorporating advanced technology and components from government and contractor funded programs. EMDP demonstrates advances in performance, durability, operability, supportability, reliability, maintainability, and unique capabilities, such as thrust reversing and vectoring nozzles. These demonstrations are in prototype derivatives of existing engines prior to engineering and manufacturing development (EMD). Early demonstration of improved engine characteristics significantly reduces risk and shortens engine development and qualification, allowing quick, cost-effective response to weapon system needs. EMDP also evaluates candidate engines (commercial or military) to provide competitive engine opportunities. EMDP ensures the Air Force has propulsion alternatives to meet near- and far-term needs. EMDP plans for and sustains the engineering development necessary to provide increased performance, reduced life cycle cost and system life extension for air breathing engines for current and future systems. This program is in budget activity 5 - Engineering and Manufacturing Development because it applies advanced technology to existing engines to demonstrate possible performance improvements.

**(U) Acquisition Strategy:**

Contracts within this Program Element are awarded sole source to engine manufacturers. EMDP tasks are generally assigned to original engine manufacturers. Tasks are assigned based on available funding and prioritization of candidate tasks.

**(U) FY 1997 (\$ in Thousands):**

- (U) \$ 100 Accomplished AGM-130 Flight Demonstration. This effort supported the gas turbine engine replacement for the weapon's current solid rocket motor. The gas turbine engine will extend the range of the AGM-130 beyond its present capability, and allow launch beyond the range of selected surface-to-air threats.
- (U) \$ 220 Continuation of T-38 Roadmapping study. Supports Air Education and Training Command (AETC) and T-38 System Program Director (SPD) request to provide and evaluate propulsion options for the T-38 aircraft fleet.
- (U) \$ 104 A-10 Roadmapping study. This effort supported an Air Combat Command (ACC) and SPD request to provide and evaluate propulsion options for the A-10 aircraft. Addressed deficiencies in Mission Area Plans. Could help reduce life cycle costs of the A-10 aircraft.
- (U) \$ 130 Studies for Global Hawk Unmanned Aerial Vehicle (UAV) and other gas turbine and hypersonic rocket systems.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
5 - Engineering and Manufacturing Development		0604218F Engine Model Derivative Program (EMDP)	2634
- (U) \$ 800	TF33 re-engining study for the B-52, KC-135, E-3A, AWACS, and JSTARS.		
- (U) \$ 120	Mission Support/Travel		
- (U) \$ 1,474	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$ 310	B-1 roadmap study. Assist the B-1 System Program Director, the Propulsion Product Group Manager and ACC in developing a long term propulsion plan of enhancements, modifications and upgrades to meet unique B-1 requirements.		
- (U) \$ 110	Completion of the TF33 re-engining study for the B-52, KC-135, E-3A, AWACS, and JSTARS.		
- (U) \$ 44	Hypersonic Rocket Study and Small Gas Turbine Engine Study.		
- (U) \$ 120	Update F-15/F-16 Engine Roadmap for ACC.		
- (U) \$ 117	Mission Support/Travel		
- (U) \$ 701	Total		
(U) FY 1999 (\$ in Thousands):			
- (U) \$ 0	Funding deleted beginning FY99		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PROJECT

5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE  
0604218F Engine Model Derivative Program

2634

(EMDP)

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget FY1998 PB	675	741	767	
(U) Appropriated Value	705	741		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-15	-24		
b. SBIR	-15	-16		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming	800			
e. Rescissions	-1		-767	
(U) Adjustments to Budget Years Since FY 1998 PB				
(U) Current Budget Submit/FY1999 President's Budget	1,474	701	0	10,584

## (U) Change Summary Explanation:

Funding: Reductions occurred to meet higher priority Air Force needs. Reprogramming of \$800K in FY97 was for a SAF/AQ directed evaluation of the re-engining of TF33 engine powered aircraft.

Schedule: N/A

Technical: Level of effort for planned studies was reduced in scope in FY97 and FY98.

## (U) C. Other Program Funding Summary (\$ in Thousands)

The following PEs do work that is technically related to EMDP, but there are no programmatic dependencies:

- (U) - PE # 0603202F, Aircraft Propulsion Subsystem Integration, provides fan and low pressure turbine technology.
- (U) - PE # 0603216F, Advanced Turbine Engine Gas Generator, provides compressor, combustor, and high pressure turbine technology.
- (U) - PE # 0602203F, Aerospace Propulsion, provides additional component and engine test data.
- (U) - PE # 0207268F, Aircraft Engine Component Improvement Program, complements EMDP by addressing engine safety problems, service-revealed deficiencies, and improved reliability, but not improved performance.
- (U) - The Air Force and Navy have a broad memorandum of understanding for joint cooperative propulsion programs in areas of common interest.
- (U) - There is no unnecessary duplication of effort within the Air Force or the Department of Defense.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

**PAGE NUMBER AND TITLE**

## PROJECT

## 5 - Engineering and Manufacturing Development

# 0604218F Engine Model Derivative Program

**2634**

**(U) D. Schedule Profile: (Task Driven)**

	FY 1997		FY 1998		FY 1999	
	1	2	1	2	1	2
(U) Start TF33 Re-engining Evaluation						
(U) Finish AGM Flight Demo						
(U) Finish T-38 Roadmap						
(U) Finish A-10 Roadmap						
(U) Finish Global Hawk Evaluation						
(U) Start B-1 Roadmap						
(U) Finish TF33 Re-engining Evaluation						
(U) Start Hypersonic Rocket Evaluation						
(U) Start F-15/F-16 Roadmap						
(U) Finish Hypersonic Rocket Evaluation						
(U) Finish B-1 Roadmap						
(U) Finish F-15/F-16 Roadmap						

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604218F Engine Model Derivative Program  
(EMDP)

2634

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY97</u>	<u>FY98</u>	<u>FY99</u>
AGM Flight Demonstration	100	0	0
T-38 Roadmap	220	0	0
A-10 Roadmap	104	0	0
Global Hawk Evaluation	130	0	0
TF33 Re-engining Evaluation	800	110	0
B-1 Roadmap	0	310	0
Hypersonic Rocket Evaluation	0	44	0
F-15/F-16 Roadmap Update	0	120	0
Mission Support	120	117	0
PE TOTAL	1,474	701	0

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604218F Engine Model Derivative Program (EMDP)

2634

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

Performing Organizations:	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
P & W	FFP/CPFF	Mar 96	\$1,457	\$1,457	\$1,379	\$ 0	\$ 78	\$ 0	\$ 0	\$1,457
GE	FFP/CPFF	Mar 96	\$2,767	\$2,767	\$1,203	\$1,124	\$ 440	\$ 0	\$ 0	\$2,767
Williams Int'l	FFP/CPFF	Mar 96	\$ 480	\$ 480	\$ 336	\$ 100	\$ 44	\$ 0	\$ 0	\$ 480
Allison	FFP/CPFF	Mar 96	\$1,695	\$1,695	\$1,578	\$ 95	\$ 22	\$ 0	\$ 0	\$1,695
Teledyne CAE	FFP/CPFF	Mar 96	\$2,918	\$2,918	\$2,883	\$ 35	\$ 0	\$ 0	\$ 0	\$2,918
Allied Signal	FFP/CPFF	Mar 96	\$ 186	\$ 186	\$ 186	\$ 0	\$ 0	\$ 0	\$ 0	\$ 186
Sundstrand	CPFF	Mar 96	\$ 1	\$ 1	\$ 1	\$ 0	\$ 0	\$ 0	\$ 0	\$ 1
Microturbo	CPFF	Mar 96	\$ 1	\$ 1	\$ 1	\$ 0	\$ 0	\$ 0	\$ 0	\$ 1
Rolls Royce	CPFF	Mar 96	\$ 1	\$ 1	\$ 1	\$ 0	\$ 0	\$ 0	\$ 0	\$ 1
Total			\$9,506	\$9,506	\$7,568	\$1,354	\$ 584	\$ 0	\$ 0	\$9,506
<u>Support and Management Organizations</u>										
In-House Support			\$1,038	\$1,038	\$ 841	\$ 120	\$ 117	\$ 0	\$ 0	\$1,078

Test and Evaluation Organizations  
Not Applicable.

Government Furnished Property: None

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

PROJECT

0604218F Engine Model Derivative Program

2634

(EMDP)

	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	\$ 7,568	\$1,354.	\$ 584	\$ 0	\$ 0	\$9,506
Subtotal Support and Management	\$ 841	\$ 120	\$ 117	\$ 0	\$ 0	\$1,078
Subtotal Test and Evaluation	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0
Total Project	\$ 8,409	\$1,474	\$ 701	\$ 0	\$ 0	\$10,584

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE
BUDGET ACTIVITY										February 1998
PE NUMBER AND TITLE										
5 - Engineering and Manufacturing Development										
0604222F Nuclear Weapons Support										
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost	6,124	4,456	4,977	5,391	5,605	6,803	7,065	Continuing	Continuing	
4236 Engineering Analysis	2,158	676	692	876	850	1,797	1,796	Continuing	Continuing	
5708 Nuclear Weapons Support	3,966	3,780	4,285	4,515	4,755	5,006	5,269	Continuing	Continuing	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**

Provides funds for maintaining core USAF nuclear weapon system expertise. Includes in-house technical capabilities, contractual efforts, supplies and equipment, travel and salaries of the USAF Nuclear Weapons Center of Excellence's civilian and military nuclear weapon and counterproliferation specialists at Kirtland Air Force Base. Provides technical guidance for continued and improved weapons capability, interoperability, safety, surety, security, development, stockpile management and retirement and counterproliferation assessments. Customers are: DoD (Air Force, Navy, Nuclear CINCs, Joint Staff, OSD and Defense Special Weapons Agency [DSWA]), DOE and NATO. Supports US Strategic Command and Air Combat Command Required Operational Capability 16-71 (Peacekeeper), 12-76 (Air Launched Cruise Missile), 6-76 (B61 Strategic Bomb), 6-69 (B83 Modern Strategic Bomb), and SAC System Operational Requirements Document 13-82-III (Advanced Cruise Missile). Air Force representative for development and implementation of the Joint DoD-DOE Surety Plan, DOE Stockpile Stewardship Plan, DoD/DOE Long Range Planning Assessment and the DoD/DOE Annual Certification. These plans document nuclear weapon issues which benefit from the application of risk assessment, data collection, model development and effectiveness analysis. Counterproliferation efforts include identifying, evaluating and assessing current and projected counterproliferation systems operating in joint environments. This work is tied to the DOE nuclear weapons development process independent of the DoD acquisition system. Weapons are always undergoing some form of RDT&E to continually assure safety, reliability and operational readiness as the DoD restructures the nation's nuclear stockpile. Therefore, USAF platforms require continuing engineering development and analysis to ensure compatibility and safety of nuclear systems. Funding this element is essential to maintaining current safety and reliability levels in the US nuclear stockpile as well as assessing current and future USAF counterproliferation needs. The USAF Nuclear Weapons Center of Excellence is responsible for all USAF nuclear weapons program management, development, systems engineering, nuclear surety engineering, engineering analyses and weapons support procedure changes. These efforts place this project in RDT&E research category/budget activity 5, Engineering and Manufacturing Development.

**(U) Acquisition Strategy:** See individual project R-2s for details.



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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE		
<b>5 - Engineering and Manufacturing Development</b>	<b>0604222F Nuclear Weapons Support</b>		
<b>(U) B. Program Change Summary (\$ in Thousands)</b>			
(U) Previous President's Budget FY 1998 PB	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	5,655	4,782	<u>Total Cost</u>
(U) Adjustments to Appropriated Value	5,788	4,782	Cont
a. Congressional/General Reductions	-133	-228	
b. SBIR		-98	
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming (BTR)	478		
e. Rescissions	-9		
(U) Adjustments to Budget Years Since FY98 PB			-28
(U) Current Budget Submit/FY 1999 President's Budget	6,124	4,456	4,977
			Cont
(U) Change Summary Explanation:			
Funding: Increase in FY97 due to additional efforts in Agent Defeat Weapon (ADW) Analysis of Alternatives Study. Reduction in FY 99 is civilian pay repricing and non-pay inflation changes.			
Schedule: N/A			
Technical: N/A			
<b>(U) C. Other Program Funding Summary (\$ in Thousands)</b>			
	FY 1997	FY 1998	FY 1999
(U) Not Applicable			FY 2000
			FY 2001
			FY 2002
			FY 2003
			To
			Compl
			Total
			Cost
<b>Related RDT&amp;E:</b>			
(U) PE0603851F, ICBM Modernization Dem/Val.			
(U) PE0604851F, ICBM Modernization EMD			
(U) PE0101122F, Air Launched Cruise Missile			
(U) PE0101120F, Advanced Cruise Missile			
(U) PE0101113F, B-52 Squadrons.			
(U) PE0101126F, B-1B Squadrons			
(U) PE0604240F, B-2 Advance Technology Bomber			
(U) PE0101127F, B-2 Squadrons.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604222F Nuclear Weapons Support									
		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost	
(U) PE0207130F/0207134F, F-15 A-D Squadrons, F-15E Squadrons.											
(U) PE0207590F SEEK EAGLE.											
(U) D. <u>Schedule Profile</u>											
Technical Capabilities Maintained For:											
Active Stockpile Weapons											
(U) - W80 (ALCM, ACM, TLAM)											
(U) - B61-7, 11, B83 (Strategic Bombs)											
(U) - B61-3, 4, 10 (Tactical Bombs)											
(U) - W62, W78, W87 (Minuteman III & Peacekeeper)											
Weapons only in Inactive Stockpile (In Storage)											
(U) - W84 (GLCM)											
Weapons in Retirement <sup>1</sup>											
(U) - W69 (SRAM A)											
(U) - W56 (Minuteman II)											
(U) - B53 Strategic Bomb											
Note1: Weapons remain in USAF custody pending DOE scheduling for shipment and dismantlement.											
Note2: Stockpile Data, i.e., IOC, retirement dates, etc. are classified											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604222F Nuclear Weapons Support								4236	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4236 Engineering Analysis		2,158	676	692	876	850	1,797	1,796	Continuing	Continuing	
<p>(U) A. <u>Mission Description and Budget Item Justification</u>  Funds the engineering analysis performed on contract for all USAF nuclear weapon systems. Contractors provide technical expertise unavailable through organic resources in critical areas of nuclear weapons safety and security, nuclear operations and counterproliferation.</p> <p>(U) <u>Acquisition Strategy</u>: Multiple small, firm fixed price contracts for contractors and MIPRs to government labs for technical analyses and technical support in safety, operations and counterproliferation assessments.</p> <p>(U) FY 1997 (\$ in Thousands)</p> <p>- (U) \$329 Nuclear Aircraft System Support. Revised and verified nuclear weapons loading, delivery, warhead mate and demate technical orders; provided support on the nuclear hardness database; provided Aircraft Monitor and Control (AMAC) software analysis and technical expertise for continued nuclear weapons integration on US and non-US aircraft systems. Developed WE1841 Test Set software and procedures for surveillance testing of the B-52H and the PA-200.</p> <p>- (U) \$1,119 Nuclear Weapons Program Support. Provided technical expertise to support development programs including the B61-11 modification, W87 life extension program, W62 life extension study, W78 life extension study, B83 spin rocket motor development plans, installation plans for B83-1/ALT 752 (new radar/height of burst), joint AF/DOE test planning, and W84 dormant storage plans; fielded and updated nuclear weapon military characteristics and/or stockpile-to-target sequences for six weapons systems; documented and supported weapon program actions, agreements, and program status including over 35 Project Officer Group reports, Annual Certification Reports; and B53 retirement plans; updated inactive stockpile plans for all systems; closed out B61-0,2,5 retirements; updated W56 dismantlement/aeroshell reuse plans, and documented W80 hedge and yield analysis studies.</p> <p>- (U) \$710 Counterproliferation Assessments. Provided technical support for the Agent Defeat Weapon (ADW) Assessment of Alternatives (AoA) Study (DoD Phase 0); developed empirical models of chemical and biological agent lethality from various concept mechanisms; estimated analytical uncertainty the Empirical Lethality Models (ELM); evaluated weapon effectiveness of conventional baseline systems against defined target set; assessed possible concept countermeasures, battle-damage-assessment (BDA), target characterization, and operational planning.</p> <p>- (U) \$2,158 Total</p>											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604222F Nuclear Weapons Support	4236	
(U) FY 1998 (\$ in Thousands)			
- (U) \$190	Nuclear Aircraft System Support. Revise and verify nuclear weapons loading, delivery, warhead mate and demate technical orders; support the US Strategic Command's nuclear safe escape effort; provide support on the nuclear hardness database; perform aircraft software analysis; develop WE1841 Test Set software and procedures for surveillance testing of the B-2A; and provide technical expertise for continued nuclear weapons integration on US and non-US aircraft systems.		
- (U) \$280	Nuclear Weapons Program Support. Provide technical expertise to support development, fielding and updates of nuclear weapon military characteristics/stockpile-to-target sequence documents; document and support all weapon safety analyses, program actions, agreements, and program status; conduct special studies on stockpile related matters, provide technical support on inactive stockpile issues, use control, long term storage, life extension and dismantlement issues to weapon Lead Project Officers and Headquarters, USAF.		
- (U) \$100	Nuclear Weapons/System Assessments. Provide technical assessments and support on nuclear safety analyses and limited special studies.		
- (U) \$106	Counterproliferation Assessments. Provide technical support for the ADW AoA Study (DoD Phase 0) including continued development of the chemical/biological ELM, assessment of countermeasures, BDA, target characterization, and operational planning; initiate experimental efforts to enhance the development of the ELM; begin efforts for Validation, Verification and Accreditation of ADW codes and models for incorporation in USAF target planning tools; continue weapon effectiveness assessment of ADW concepts against the ADW target set; and provide other service expertise in the definition and development of issues related to ADW and counterproliferation.		
- (U) \$676	Total		
(U) FY 1999 (\$ in Thousands)			
- (U) \$192	Nuclear Aircraft System Support. Revise and verify nuclear weapons loading, delivery, warhead mate and demate technical orders; provide support on the nuclear hardness database, perform aircraft software analysis; and provide technical expertise for continued nuclear weapons integration on US and non-US aircraft systems.		
- (U) \$300	Nuclear Weapons Program Support. Provide technical expertise to support development, fielding and updates of nuclear weapon military characteristics/stockpile-to-target sequence documents; document and support all weapons safety analyses, program actions, agreements, and program status; conduct special studies on stockpile related matters, provide technical support on inactive stockpile issues, use control, long term storage, life extension and dismantlement issues to weapon Lead Project Officers and Headquarters, USAF.		
- (U) \$100	Nuclear Weapons/System Assessments. Provide technical assessments and support on nuclear safety analyses and limited special studies.		
- (U) \$100	Counterproliferation Assessments. Provide technical support for the ADW AoA Study (DoD Phase 0) including technical expertise in the evaluation of nuclear, thermal, chemical, emitter and conventional systems identified as possible Agent Defeat concepts; enhance the ELM; complete Validation, Verification and Accreditation of ADW codes and models for incorporation in USAF target planning tools; and support final Intelligence Support Plan (ISP) requirements of ADW alternatives.		
- (U) \$692	Total		
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
<b>5 - Engineering and Manufacturing Development</b>	<b>0604222F Nuclear Weapons Support</b>	<b>4236</b>	
<b>(U) B. Program Change Summary (\$ in Thousands)</b>			
		<u>FY 1997</u>	<u>FY 1998</u>
(U) Previous President's Budget FY 1998 PB		1,689	715
(U) Appropriated Value		1,726	715
(U) Adjustments to Appropriated Value			
a. Congressional/General Reductions		-46	-24
b. SBIR			-15
c. Omnibus or Other Above Threshold Reprogramming			
d. Below Threshold Reprogramming		478	
e. Rescissions			
(U) Adjustments to Budget Years Since FY98 PB			
(U) Current Budget Submit/FY 1999 President's Budget		2,158	676
			-14
			692
			Cont
(U) Change Summary Explanation:			
Funding: Increase in FY97 due to additional efforts in Agent Defeat Warhead (ADW) Analysis of Alternatives Study. Changes in FY 99 due to non-pay inflation changes.			
Schedule: N/A			
Technical: N/A			
<b>(U) C. Other Program Funding Summary (\$ in Thousands)</b>			
(U) Not Applicable			
<b>(U) D. Schedule Profile</b>			
(U) Not Applicable			
Project 4236			
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		4236
5 - Engineering and Manufacturing Development	0604222F Nuclear Weapons Support		
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>			
	FY 1997	FY 1998	FY 1999
(U) Contractor Engineering Support	2,158	676	692
(U) Total	2,158	676	692
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>			
<u>Performing Organizations:</u>			
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC
			Project Office EAC
			Total Prior to FY 1997
			Budget FY 1997
			FY 1998
			FY 1999
			Budget to Complete
			Total Program
<u>Product Development Organizations</u>			
Miscellaneous	MIPR/FFP	1Q FY98	NA
DOE/Albuquerque Ops, Albuquerque, NM			NA
TECH REPS, Inc., Albuquerque, NM			NA
Orion International, Albuquerque, NM			NA
Naval Air Warfare Center, Indianapolis, IN			NA
Silicon Graphics, Albuquerque, NM			NA
Kaman Sciences Corp, Boston MA			NA
Albuquerque Logistics, Albuquerque, NM			NA
<u>Support and Management Organizations</u>			
None			
<u>Test and Evaluation Organizations</u>			
None			

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BUDGET ACTIVITY		RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	PROJECT
5 - Engineering and Manufacturing Development		PE NUMBER AND TITLE		0604222F Nuclear Weapons Support	
				February 1998	
				4236	
(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)					
Government Furnished Property:					
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997
					FY 1998
					FY 1999
					Budget to Complete
					Total Program
Product Development Property None					
Support and Management Property None					
Test and Evaluation Property None					
Subtotal Product Development					
Subtotal Support and Management					
Subtotal Test and Evaluation					
Total Project					
				2,158	676
				0	0
				0	0
				2,158	676
				692	Cont
				0	0
				0	0
				692	Cont

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE		February 1998						
BUDGET ACTIVITY		PE NUMBER AND TITLE				PROJECT				
5 - Engineering and Manufacturing Development		0604222F Nuclear Weapons Support				5708				
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
5708	Nuclear Weapons Support	3,966	3,780	4,285	4,515	4,755	5,006	5,269	Continuing	Continuing
<p>(U) <b>A. Mission Description and Budget Item Justification</b>  Funds Air Force Nuclear Center of Excellence civilians at Kirtland AFB, New Mexico providing technical and engineering support for all USAF nuclear weapon systems and counterproliferation technical efforts.</p> <p>(U) <b>Acquisition Strategy:</b> RDT&amp;E funds primarily provide for Air Force technical civilian personnel providing nuclear weapons management and development. These scientists and engineers interface with Air Force nuclear weapon System Program Offices, operational commands and the Department of Energy, performing engineering development and analysis to ensure continued and improved weapons safety, security, reliability and compatibility.</p> <p>(U) <b>FY 1997 (\$ in Thousands)</b>  - (U) \$1,050 Nuclear Aircraft System Support. Updated all fighter aircraft safe escape information and generated initial B-2A safe escape data for inclusion into the aircrew delivery manuals; supported the US Strike Aircraft Operational Safety Review and C-17A Special Safety Study; continued management of the F-15E, B-52H and B-2A Project Officers Groups (POGs) and the Nuclear Air Logistics POG; provided support for the B-2A Nuclear Certification Working Group and the F-16 and B-1B Project Officers Groups; completed nuclear safety design certification evaluation of the C-17A; issued nuclear compatibility certification statement for F-15E/B61; provided technical support for efforts to upgrade the use control devices on the strategic weapon systems, the F-15E Programmable Armament Control Set (PACS), B-1B Block E design for nuclear capability roll-in, and for the F-16A/B and PA-200 Tornado aircraft weapons system hardware/software update and upgrade; conducted nuclear weapon Aircraft Monitor and Control (AMAC) tests on the F-16C/D Modular Mission Computer upgrade and B-2A Block 20 modification; conducted B61-11 Mechanical Fit Test and B-61-11 Full System Demonstration Test; conducted evaluations of nuclear weapon system incidents; completed engineering analysis of load conditions on Nuclear Weapon Storage Vault (WSV) resulting from conventional explosive detonations within a Hardened Aircraft Shelter (HAS); verified the WE1841 Test Set software for the B-52H surveillance test program on the B-52H simulator; provided revisions, changes and updates to nuclear Weapons Technical Orders resulting from systems and weapons hardware/software changes; chaired Technical Order review, validation/verification, and technical content conferences.</p>										

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT		
5 - Engineering and Manufacturing Development	0604222F Nuclear Weapons Support	5708		
- (U) \$782	Nuclear Ground-Launched Missile (ICBM) Support. Supported START I and START II treaties during Minuteman III base transfers; provided nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provided nuclear surety design guidance to the ICBM program office/contractors for the Minuteman III Guidance Replacement Program , the Airborne Launch Control System (ALCS) transition to the Navy E6B Aircraft Program, Boeing Guidance Replacement Program, ICBM Nuclear Safety Cross Check Analysis/Independent Validation & Verification contract proposal, Minuteman III Propulsion Replacement Program, ICBM Wing Code Processing System, Hardness Surveillance Electromagnetic Pulse Program, Explosive Set Circuitry Test Set, and Minuteman III Payload Transporter Type III; supported the Minuteman III System-Wide Unauthorized Launch Study (ULS) Working Group, the ULS Senior Steering Group, and the ICBM Nuclear Surety Working Group; conducted the Independent Technical Nuclear Safety Analysis for the ALCS Transition to the Navy E6B Aircraft Program for the Nuclear Weapon System Safety Group (NWSSG) Special Safety Study of the ALCS; and supported activities for resolutions of open ICBM Weapon System NWSSG recommendations.			
- (U) \$1,142	Nuclear Weapons Program Support. Accomplished nuclear weapon safety, reliability, mission analysis and compatibility studies including the 1996 Annual Certification Reports; supported stockpile activities including the W62 Life Extension Study, W62 Cost/Benefit/Risk Study, 90 Day W78 Life Extension Study, W87 Life Extension Program, W80 Life Extension Assessment, Hedge Analysis and Yield Assessment; completed weapon use control analyses for B61 and ICBM warheads and W80/W84 storage assessments; concluded interim certification on the B61-11 modification program; approved revisions to W80, B61 and B83 Military Characteristics and Stockpile-to-Target documents and finalized new documents for the B61-11 program; continued to manage the nuclear warhead project officer groups; continued the life extension assessment activities to examine current status, anticipated age-related degradation problems, estimated replacement need dates and likely problems due to sunset technology and changes to the DOE production complex; continued to develop plans for treaty driven stockpile reconfigurations (Single Reentry Vehicle/ Safety Enhanced Reentry Vehicle) and inactive stockpile plans; and initiated reliability testing assessments (Single Nuclear Weapons/Systems Assessments. Performed analysis, testing and documentation of the Kirtland Underground Munitions Storage Complex's (KUMSC) Blast Containment System for various facility configurations; completed the B-52 Positive Control IPT study and a probability assessment for inadvertent nuclear detonation for the B53-1 for ALT 925 and non-ALT 925 weapons; supported and researched the polywall structure and fragmentation issue in TP 20-7.			
- (U) \$400	Counterproliferation Assessments. Provided technical guidance and support for the Agent Defeat Weapon (ADW) Assessment of Alternatives (AoA) Study (DoD Phase 0); provided program guidance and technical expertise in the evaluation of nuclear, thermal, chemical, emitter and conventional systems identified as possible Agent Defeat concepts; performed weapon effectiveness assessments for nuclear and non-nuclear baseline and conceptual weapon alternatives; and provided collateral damage assessments of ADW baseline weapon systems.			
- (U) \$3,966	Total			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT		
5 - Engineering and Manufacturing Development	0604222F Nuclear Weapons Support	5708		
(U) FY 1998 (\$ in Thousands)				
-- (U) \$1,030	Nuclear Aircraft System Support. Continue FY 1997 level of effort: support the US Strategic Command's nuclear safe escape effort; update/expand nuclear hardness database; conduct nuclear aircraft weapon system surveillance test program; provide technical support required by NWSSG action items, Special Safety Studies, and Operational Safety Reviews; perform independent engineering nuclear safety evaluations; support design, development, standardization and procurement of stores management systems for nuclear weapons command and control; provide nuclear surety and compatibility design criteria, standards, specifications, and related requirements documents for all USAF nuclear capable aircraft weapon systems; manage the B-52H, F-15E and B-2A POCs and Nuclear Airlift POG; perform an independent analysis of the B-2A Block 30 software; direct aircraft compatibility testing on the B-2A, B-52H and B-1B; perform independent engineering evaluations for nuclear safety design certification of nuclear weapon system modifications; perform engineering evaluations and support testing required for nuclear weapon compatibility certification; issue AF Nuclear Compatibility Certification Statements for the F-16C/D, B-52H, B-2A and B-1B; provide revisions, changes and updates to nuclear weapons Technical Orders resulting from systems and weapons hardware/software changes; chair Technical Order review, validation/verification, and technical content conferences.			
-- (U) \$680	Nuclear Ground-Launched Missile (ICBM) Support. Continue FY 1997 level of effort: provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provide nuclear surety design guidance to ICBM program office/contractors for Minuteman III Guidance Replacement Program (GRP), the Minuteman III Propulsion Replacement Program, modification required for Peacekeeper Weapon System Sustainment, and other weapon system modification and upgrade programs; provide nuclear certification support; perform independent nuclear surety analyses for nuclear safety design certification of weapon system modifications and upgrade programs; provide AFMC NWSSG member, technical advisors and technical support to the ICBM NWSSG Operational Safety Review; and provide support for NWSSG Special Safety Studies as required.			
-- (U) \$1,120	Nuclear Weapons Program Support. Continue FY 1997 level of effort: accomplish nuclear weapon safety, reliability, mission analysis and compatibility studies; support USAF nuclear weapon stockpile activities, weapon use control analyses and environmental and intrinsic radiation studies; continue life extension assessments to develop, plan, schedule and execute programs for safety, security, reliability and operability actions for B61, B83, W80 and ICBM warheads; continue to develop reconfiguration and inactive stockpile plans; complete the B61-11 program; continue support to USAF, DoD and other agencies in all facets of nuclear arsenal.			
-- (U) \$700	Nuclear Weapons/Systems Assessments. Continue FY 1997 level of effort: begin to apply joint DoD/DOE nuclear surety assessment methodology on abnormal nuclear environments analyses ; conduct fault tree analyses of nuclear weapons and weapon systems; provide other special assessments as capable.			
-- (U) \$250	Counterproliferation Assessments. Continue FY 1997 level of effort: Provide technical guidance and support for the ADW Assessment of Alternatives (AoA) Study; provide overall program guidance and technical expertise in the evaluation of nuclear, thermal, chemical, emitter and conventional systems identified as possible Agent Defeat concepts; provide continued analytical support of nuclear, non-nuclear and advanced weapon system concepts and assessing unique ADW intelligence and battle damage assessment (BDA) requirements.			
-- (U) \$3,780	Total			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604222F Nuclear Weapons Support	5708	
(U) FY 1999 (\$ in Thousands)			
- (U) \$1,150	Nuclear Aircraft System Support. Continue FY 1998 level of effort: support the US Strategic Command's nuclear safe escape effort; update/expand nuclear hardness database; conduct nuclear aircraft weapon system surveillance test programs; provide technical support required by NWSSG action items, Special Safety Studies, and Operational Safety Reviews; perform independent nuclear safety analyses; support design, development, standardization and procurement of stores management systems for nuclear weapons command and control; provide nuclear surety and compatibility design criteria, standards, specifications, and related requirements documents for all USAF nuclear capable aircraft weapon systems; manage the B-52H, F-15E, B-2A and Nuclear Airlift POGs; direct nuclear weapon aircraft interface testing on delivery aircraft as required; perform independent engineering evaluations for nuclear safety design certification of nuclear weapon system modifications; perform engineering evaluations and support testing required for nuclear weapon compatibility certification; provide revisions, changes and updates to nuclear weapon Technical Orders, resulting from system and weapon hardware/software changes; chair Technical Order review, validation/verification, and technical content conferences.		
- (U) \$770	Nuclear Ground-Launched Missile (ICBM) Support. Continue FY 1998 level of effort: provide nuclear surety design criteria, standards, specifications, and related requirements documents for all USAF ground-launched missile systems; provide nuclear surety design guidance to ICBM program office/contractors for weapon system modifications and upgrade programs, perform independent nuclear surety analyses for nuclear safety design certification of weapon system modifications; provide nuclear certification support; complete nuclear safety analysis for nuclear safety design certification of the Minuteman III GRP Program; and support NWSSG action items and Special Safety Studies as required.		
- (U) \$1,290	Nuclear Weapons Program Support. Continue FY 1998 level of effort: accomplish nuclear weapon safety, reliability, mission analysis and compatibility studies, support USAF nuclear weapon stockpile activities, weapon use control analyses; and environmental and intrinsic radiation studies; continue to develop, plan, schedule and execute nuclear weapon life extension programs for safety, security, reliability and operability actions for B61, B83, W80 and ICBM warheads; continue to develop reconfiguration and inactive stockpile plans; continue support to USAF, DoD and other agencies in all facets of nuclear arsenal.		
- (U) \$777	Nuclear Weapons/Systems Assessments. Continue FY 1998 level of effort: continue application of joint DoD/DOE nuclear surety assessment methodology to abnormal nuclear environment analyses; conduct fault tree analyses of nuclear weapons and weapon systems; provide other special assessments as capable.		
- (U) \$298	Counterproliferation Assessments. Continue FY 1998 level of effort: Provide technical guidance and support for the ADW AoA Phase 0 Study leading to a Milestone I decision fourth quarter FY98; provide overall program guidance and technical expertise in the evaluation of nuclear, thermal, chemical, emitter and conventional systems identified as possible Agent Defeat concepts; provide technical support for current, proposed and future counterproliferation efforts of interest to the USAF.		
- (U) \$4,285	Total		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604222F Nuclear Weapons Support

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(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Cont
(U) Previous President's Budget FY 1998 PB	3,966	4,067	4,299	
(U) Appropriated Value	4,062	4,067		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-87	-204		
b. SBIR		-83		
c. Omnibus or Other Above Threshold Reprogramming				
d. Below Threshold Reprogramming (BTR)				
e. Rescissions	-9		-14	
(U) Adjustments to Budget Years Since FY 1998 PB				
(U) Current Budget Submit/FY 1999 President's Budget	3,966	3,780	4,285	Cont

## (U) Change Summary Explanation:

Funding: Changes in FY99 due to civilian pay repricing.

Schedule: N/A

Technical: N/A

(U) C. Other Program Funding Summary (\$ in Thousands)

(U) Not Applicable

(U) D. Schedule Profile

(U) Not Applicable

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	PROJECT
BUDGET ACTIVITY		PE NUMBER AND TITLE			
5 - Engineering and Manufacturing Development		0604222F Nuclear Weapons Support		February 1998	
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>					
		FY 1997	FY 1998	FY 1999	
(U) Program Management Personnel		234	239	244	
(U) Research Personnel		2,870	2,927	2,985	
(U) Travel		275	275	325	
(U) Training Development		150	150	175	
(U) Research Support Equipment Acquisition		125	125	150	
(U) Miscellaneous		312	64	406	
(U) Total		3,966	3,780	4,285	
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>					
Performing Organizations:					
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997
					Budget FY 1997
					FY 1998
					FY 1999
					Budget to Complete
					Total Program
Product Development Organizations					
SA-ALC/NWI	N/A	N/A	N/A	3,966	3,780
				4,285	Cont
Support and Management Organizations					
None					
Test and Evaluation Organizations					
None					

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604222F Nuclear Weapons Support

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(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

## Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total		Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
				Prior to FY 1997						

Product Development Property None

Support and Management Property None

Test and Evaluation Property None

Subtotal Product Development	Cont	3,966	3,780	4,285	Cont	Cont
Subtotal Support and Management	0	0	0	0	0	0
Subtotal Test and Evaluation	0	0	0	0	0	0
Total Project	Cont	3,966	3,780	4,285	Cont	Cont

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

0604226F B-1B

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	207,386	208,222	195,385	204,749	136,850	38,322	5,182	0	1,363,041
1019 ECM Improvements*	42,714	0	0	0	0	0	0	0	76,182
1020 AFMSS*	10,739	0	0	0	0	0	0	0	20,162
1021 B-1 Simulator*	5,418	0	0	0	0	0	0	0	9,416
4143 Conventional Weapons Upgrade*	148,515	0	0	0	0	0	0	0	468,571
4596 Conventional Mission Upgrade*	0	208,222	195,385	204,749	136,850	38,322	5,182	0	788,710
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

\* BPACs 1019, 1020, 1021, and 4143 were consolidated into BPAC 4596 beginning in FY98.

(U) A. Mission Description and Budget Item Justification

(U) With the drawdown of forward-based US ground, naval, and tactical air forces, current defense strategy calls for long range, conventionally armed strategic bombers to play a major role in the initial stages of a regional contingency. The 94 B-1B Lancers in the Air Force inventory will constitute over one-half of all US strategic bombers -- making them the centerpiece of the conventional bomber force well into the next century. To maximize the B-1's contribution in this role, the Air Force must enhance the B-1's capability to perform precision attacks against moderately defended targets deep in enemy airspace. The needed enhancements fall primarily into two categories: improved lethality through integration of advanced conventional weapons, and improved survivability through upgrades to the electronic countermeasures (ECM) system. The Air Force established the Conventional Mission Upgrade Program (CMUP) to fulfill these requirements.

(U) This Program Element provides RDT&E funding for CMUP. The program improves the B-1's effectiveness in conventional operations by integrating advanced conventional weapons. Required Assets Available (RAA) of Cluster Bomb Units (CBUs) was achieved in September 1996. Funding in the FYDP covers integration of the Joint Direct Attack Munition (JDAM), Wind Corrected Munitions Dispenser (WCMD), Joint Stand-Off Weapon (JSOW), Joint Air to Surface Stand-Off Missile (JASSM), and upgrades to the ECM suite. Parallel efforts include an upgrade to the avionics computers to enable simultaneous carriage of multiple weapon types (one type per bay), provide growth capability, and reduce support costs; development of an interface to the Air Force Mission Support System (AFMSS) for more effective employment of the B-1 in a theater scenario; and upgrades to the air crew and maintenance training systems to keep them consistent with the aircraft's configuration.

The FY99 program includes work in Research Category/Budget Activity Engineering and Manufacturing Development structured in development blocks, as well as Live Fire Test and Evaluation, as follows:

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(U) **Block C:** Integration of CBUs (EMD completed in FY95, FOC 4QFY97). (Formerly Project 4143, Conventional Weapons Upgrade)  
 (U) **Block D:** Aircraft enhancements include the JDAM integration effort, an anti-jam secure-voice radio (communications upgrade) for improved interoperability with other theater forces, a Mil-Std-1760 electrical interconnection system which provides a common interface between aircraft and precision weapons, and a Global Positioning System (GPS) receiver to provide position updates to precision weapons. SECAF accelerated procurement of JDAM modification kits for seven aircraft. ALE-50 (Towed Decoy System), currently managed under PE 0604270F, was accelerated in conjunction with JDAM to yield enhanced operational capability in FY99. (Formerly Project 4143, Conventional Weapons Upgrade)

(U) **Block E:** (Computer Upgrade and WCMD Integration Program): Includes an upgraded avionics computer suite which will significantly improve computer reliability and maintainability (projected \$40M O&S savings per year after full fleet modification) and improvements to handle advanced weapons requirements including integration of WCMD. (Formerly Project 4143, Conventional Weapons Upgrade)

(U) **Block E Delta:** Develop necessary modifications to integrate JSOW and JASSM

(U) **Block F:** (Defensive System Upgrade Program (DSUP)): The existing ALQ-161 defensive system, designed for the strategic nuclear mission (i.e., low altitude penetration against specific air defense threats), has limited effectiveness in the B-1B's new conventional mission. DSUP will remove most of the ALQ-161 system and replace it with an upgraded AN/ALR-56M radar warning receiver and the RF Countermeasures (RFCM) portion of the Navy's IDECM program, which includes a techniques generator and a fiber optic towed decoy. These new systems will significantly improve situational awareness and the survivability of the B-1B in the medium and high altitude regimes where most conventional missions will be conducted. These enhancements are required to maximize the effectiveness of the new weapons capability provided under CMUP. Additionally, these modifications will eventually reduce annual O&S costs approximately \$50-60M per year after full fleet modification. (Formerly Project 1019, ECM Improvements)

(U) **Other CMUP Related Development:** Studies and design definition for Data Link Implementation, EMD work associated with the congressional plus-up for additional Enhanced Conventional Bomb Module's (ECBM's), Intermediate Wing Sweep Studies and Verification, preliminary engineering and planning studies for potential future weapon system enhancements and weapon system operational support improvements.

(U) **B-1B Mission Planning System (MPS):** Consists of improved B-1 mission planning capabilities by developing an aircraft specific software module to interface with the ongoing AFMSS program. While AFMSS provides common mission planning capabilities for all aircraft, the aircraft, weapons, and electronics (A/W/E) hardware and software on each type aircraft provide unique interfaces and functionality not provided by the AFMSS "core" system. The B-1 A/W/E module provides those aircraft unique interfaces to achieve enhanced route planning, penetration, and weapons delivery capabilities. AFMSS replaces the aging Mission Data Preparation System which is no longer fully supportable and does not meet current mission requirements. This A/W/E module will be developed concurrently with the AFMSS core software and the B-1 operational flight programs. Once the initial B-1 A/W/E is developed and fielded, it must continue to be updated to remain consistent with and provide capability for subsequent block developments. (Formerly Project 1020, AFMSS)

(U) **Training Systems:** Provides updates to the existing training system necessary to match changes made to the aircraft described in the other sections. The total B-1 Training System consists of the Simulator System (SS) to train air crew members and Maintenance Training Equipment (MTE) to train maintenance personnel. The SS is a suite of systems which provides the necessary visual, motion, and aural cues for complete ground training of B-1 air crew members -- there are five Weapon System Trainers, five Cockpit Procedure Trainers, two Mission Trainers and one Training System Support Center (TSSC). The TSSC includes the computational system resources required to support software, hardware, and firmware changes. The MTE provides maintenance training for simulation of fault isolation and removal/replacement of all B-1 aircraft systems. The MTE, also a suite of systems, includes eight Avionics/Armament Maintenance Training Systems, 10 Simulator

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Maintenance Training Systems, one Primary/Secondary Flight Control System Maintenance Trainer and one TSSC to support software, hardware, and firmware changes. (Formerly Project 1021, B-1 Simulators)			
<p>(U) <b>Acquisition Strategy:</b></p> <p>(U) These major upgrades will be accomplished and integrated in conjunction with ongoing sustainment block upgrades. RDT&amp;E work on the Block C CBU upgrade was completed in FY95. Boeing North American (formerly Rockwell International, North American Aircraft Division) is the integrating contractor for all major aircraft upgrades. B-1 MPS and training system upgrades will be released periodically during the individual blocks.</p> <p>(U) Key elements of the overall CMUP acquisition strategy include: use of sole source contract with a prime/integrating contractor; assignment of Total System Installed Performance Responsibility (TSIPR) to the integrating contractor; use of cost plus award fee (CPAF) development contracts; and combining developmental upgrades with software sustainment blocks to minimize number of software releases, aircraft downtime and differences in fielded configurations.</p> <p>(U) The ten test articles purchased in FY97 (\$5,140) were computer set kits (six to be installed in labs to support Block E EMD, two for Block E test aircraft, one to be installed in the lab to support Block F EMD, and one for the DSUP test aircraft). The twelve test articles to be purchased in FY98 consist of seven computer set kits (\$3,598) (five to be installed in labs, and two as test spares) and five DSUP kits (\$5,418) to support Block F EMD (three in labs and two in aircraft). The three test articles to be purchased in FY00 consist of three JSOW/JASSM aircraft launcher kits to be installed in the lab and test aircraft.</p> <p>(U) <b>B. <u>Program Change Summary (\$ in Thousands)</u></b> See Project R-2 Exhibit</p> <p>(U) <b>C. <u>Other Program Funding Summary (\$ in Thousands)</u></b> See Project R-2 Exhibit</p> <p>(U) <b>D. <u>Schedule Profile</u></b> See Project R-2 Exhibit</p>			

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PROJECT

4596

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4596 Conventional Mission Upgrade*	0	208,222	195,385	204,749	136,850	38,322	5,182	0	788,710

\*BPAC 4596 resulted from the consolidation of BPACs 1019, 1020, 1021, and 4143 beginning in FY98. In FY97 the total was \$207,386 and the total program cost is \$1,363,041.

(U) A. Mission Description and Budget Item Justification

(U) The B-1 will deliver most of the heavy bomber fleet's conventional weapons in future conflicts. The original B-1 conventional combat capability was optimized for delivery of MK-82 non-precision 500 pound gravity bombs. The increase in the B-1's conventional weapons employment capability involves upgrading the following systems:

- (U) CBUs: Modify 50 of the 101 existing B-1 conventional bomb modules to provide the capability to employ cluster bomb units (CBUs). The modified modules completed delivery 4QFY97.
- (U) GPS/Communications Navigation Management System/JDAM/Mil-Std-1760: Incorporate Global Positioning System (GPS) capability for more precise long range navigation, TACAN emulation, and weapons delivery. Integrate the ARC-210 "HAVE QUICK" secure/anti-jam communications system for improved capability to operate within force packages. Includes Voice Demand Assigned Multiple Access/Advanced Narrowband Digital Voice Terminal (DAMA/ANDVT), a SATCOM required communications upgrade. Also modifies the B-1 rotary launcher to accommodate carriage of JDAM and other advanced conventional weapons. Incorporates Mil-Std-1760 weapons interface for use with JDAM and other precision weapons.
- (U) Computers: Upgrade the current avionics computer complex to provide for weapons flexibility and reduce operation and support costs. Existing avionics computers will be replaced with modern, 32-bit hardware, and current software will be converted to Ada.
- (U) Wind Corrected Munitions Dispenser (WCMD): Add Mil-Std-1760 weapon interface to modified conventional bomb modules (see "CBUs" above) to allow B-1 to employ WCMD. Increases accuracy of CBUs when released at high altitudes, reducing target passes.
- (U) JSOW/JASSM: Develop necessary modifications to integrate JSOW and JASSM.
- (U) DSUP: Provides defensive system enhancements in: situational awareness, countermeasures effectiveness and reliability and maintainability

(U) Acquisition Strategy:

(U) The Conventional Mission Upgrade Program is managed in Blocks. In each Block, cost type contracts are used for EMD and fixed price contracts for production/mod kits:

- (U) Block C: Enhanced capability (but unguided) weapons (CBU-87/89/97) integration (Completed development in FY95)
- (U) Block D: Near precision weapons integration (JDAM/1760/GPS/Comm).
- (U) Block E: Upgrading of the avionics computers and integration of WCMD (CBU-103/104/105).
- (U) Block E Delta: Integrating JSOW and JASSM onto the aircraft.
- (U) Block F: Upgrade of defensive avionics system to include integration of AN/ALR-56M and IDECM RFCM system.

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<p>(U) Other CMUP Related Development - Studies and design definition for Data Link Implementation, EMD work associated with the congressional plus-up for additional CBM's, Intermediate Wing Sweep Studies and Verification, preliminary engineering and planning studies for potential future weapon system enhancements and weapon system operational support improvements.</p> <p>(U) MPS: ESC/YV manages the B-1B Mission Planning development effort of the B-1 A/W/E, with ASC/YD retaining program management and funding authority for the program. Together, the organizations report to AFPEO/FB, the Program Executive Officer for Fighters and Bombers. The Government awarded a cost-plus-award-fee (CPAF) contract to Logicon for development of this A/W/E, using full-and-open competition and streamlined source selection. The Air Force plans a "single, combined release" of the B-1B Block C/D A/W/E software. This will provide the full functionality required for both the CBU (Block C) and JDAM/1760/GPS/Comm (Block D) upgrades. The single Block C/Block D combined release procurement goes through 3QFY98 with planned follow-on software development related to OFP changes for Blocks E and F and any evolving B-1 mission planning requirements through FY02.</p> <p>(U) Training Systems: The Simulator upgrade is funded through a 5-year contract awarded 21 Jun 94 to Lockheed-Martin Training &amp; Technical Services. This contract encompasses development, production and Contractor Logistic Support (CLS) through FY99. The development portion is a cost-plus-award-fee (CPAF) type contract and production is firm-fixed-price (FFP). The CLS is fixed-price-award-fee (FPAF) for the simulator system and FFP for the maintenance training equipment. Time and Materials contracts will be used for over and above work on both the simulator system and MTE.</p> <p>(U) Government organizations responsible for various development efforts include: the B-1B System Program Office (SPO) and Training Systems SPO at ASC, Wright-Patterson AFB, OH; Oklahoma City Air Logistics Center (OC-ALC), Tinker AFB, OK; Warner Robins Air Logistics Center (WR-ALC), Robins AFB, GA; JDAM/JSOW/JASSM/WCMD SPO, Eglin AFB, FL; GPS Joint PO (JPO), Los Angeles AFB, CA; Mission Planning SPO at ESC, Hanscom AFB, MA; Rome Laboratories, Griffiss AFB, NY; Air Force Flight Test Center (AFFTC), Edwards AFB, CA; Air Force Developmental Test Center (AFDTC), Eglin AFB, FL; and Air Force Operational Test and Evaluation Center (AFOTEC), Kirtland AFB, NM.</p>			

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## (U) FY 1997 (\$ in Thousands):

- (U) \$5,239 (Other) Studies and design definition for data link implementation  
 - (U) \$1,000 (Other) Began Intermediate Wing Sweep Studies  
 - (U) \$79,513 (Block D) Continued integration for JDAM, 1760, GPS and Communications Navigation Management System  
 - (U) \$32,186 (Block E) Continued EMD for Computer upgrade  
 - (U) \$7,858 (Block E) Continued EMD for WCMD integration  
 - (U) \$450 (Block E Delta) Continued ICD work on JSOW integration  
 - (U) \$13,757 (Block F) Continued DSUP pre-EMD contractor systems engineering process, culminating in System Functional Review (SFR)  
 - (U) \$23,555 (Block F) Began DSUP EMD  
 - (U) \$9,899 (MPS) Continued Logicon contract  
 - (U) \$80 (MPS) Contract support (Lockheed-Martin)  
 - (U) \$95 (Training Systems) ACA with Logicon  
 - (U) \$3,118 (Training Systems) MTE computer rehost  
 - (U) \$188 (Training Systems) EMD WST Storage  
 - (U) \$734 (Training Systems) Begin Block D development  
 - (U) \$64 (Training Systems) IVACC Delay II  
 - (U) \$14,737 Government flight test and planning  
 - (U) \$4,483 GFE  
 - (U) \$3,446 CAAS  
 - (U) \$1,121 Modeling & Simulation / Studies & Analyses  
 - (U) \$5,863 Program Management Administration  
 - (U) \$207,386 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$1,900 (Other) EMD work to integrate additional CBM's  
 - (U) \$1,995 (Other) Complete Intermediate Wing Sweep Studies  
 - (U) \$40,718 (Block D) Continue integration activities for JDAM, 1760, GPS and Communications Navigation Management System  
 - (U) \$43,790 (Block E) Continue EMD for Computer upgrade  
 - (U) \$9,613 (Block E) Continue EMD for WCMD integration  
 - (U) \$7,200 (Block E Delta) Conduct acquisition & interface planning to support FY99 EMD start for JSOW & JASSM integration  
 - (U) \$47,500 (Block F) Continue DSUP EMD activities  
 - (U) \$9,897 (MPS) Continue Logicon contract  
 - (U) \$150 (MPS) Continue Lockheed Martin contract

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-	(U)	\$4,215 (Training Systems) Continue Block D development		
-	(U)	\$1,399 (Training Systems) Continue MTE computer rehost		
-	(U)	\$3,204 GFE		
-	(U)	\$21,617 Government flight test		
-	(U)	\$2,632 ECO		
-	(U)	\$2,920 CAAS		
-	(U)	\$1,370 Modeling & Simulation / Studies & Analyses		
-	(U)	\$5,303 Mission Support		
-	(U)	\$2,799 Pending reprogramming to higher AF priority programs		
-	(U)	\$208,222 Total		
(U) FY 1999 (\$ in Thousands):				
-	(U)	\$200 (Other) Complete EMD work to integrate additional CBM's		
-	(U)	\$350 (Other) Complete Intermediate Wing Sweep Studies and Verification		
-	(U)	\$5,100 (Block D) Complete integration activities for JDAM, 1760, GPS and Communications Navigation Management System		
-	(U)	\$43,632 (Block E) Continue EMD for Computer upgrade		
-	(U)	\$9,569 (Block E) Continue EMD for WCMD integration		
-	(U)	\$16,957 (Block E Delta) Begin EMD for JSOW & JASSM integration		
-	(U)	\$61,666 (Block F) Continue DSUP EMD activities		
-	(U)	\$9,636 (MPS) Continue Logicon contract		
-	(U)	\$150 (MPS) Continue Lockheed-Martin support		
-	(U)	\$9,058 (Training Systems) Continue Block D development		
-	(U)	\$930 GFE		
-	(U)	\$23,451 Government flight test		
-	(U)	\$4,003 ECO		
-	(U)	\$3,146 CAAS		
-	(U)	\$2,500 Modeling & Simulation / Studies & Analyses		
-	(U)	\$5,037 Mission Support		
-	(U)	\$195,385 Total		

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(U) B. Program Change Summary (\$ in Thousands)

Total  
Cost

1,388,757

FY 1997

207,930

217,732

FY 1998

216,886

220,886

FY 1999

199,718

(U) Previous President's Budget (FY 1998 PB)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

a. Cong Reductions

b. SBIR

c. Omnibus or Other Above Threshold Reprogram

d. Below Threshold Reprogramming

e. Rescissions

(U) Adjustments to Budget Years Since FY 1998 PB

(U) Current Budget Submit/FY1999 President's Budget

(U) Change Summary Explanation:

Funding:

(U) FY99 (-4,333): Funding was aligned with the current estimate for DSUP SCP (+1,007), Delay JSOW/JASSM EMD (-1,400)

Schedule: None

Technical: None

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(U) C. Other Program Funding Summary (\$ in Thousands)											
		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total	
(U) PE 0101126F, Aircraft Procurement (B-1);		51,683	62,400	75,147	108,700	89,381	152,429	144,546	Compl	Cost	
BP11, Modifications (CMUP-related only)									311,818	852,939	
(U) PE 0101126F, Other Procurement (B-1)		32,000								32,000	
(U) PE 0207442F, EW Production (TDS/IDECM)		3,700	21,825	0	0	6,859	8,568	7,502	25,500	91,254	
<b>Related RDT&amp;E:</b>											
(U) Program Element 0205164F, Global Positioning System (GPS)											
(U) Program Element 0207325F, Joint Air to Surface Standoff Missile (JASSM)											
(U) Program Element 0604618F/N, Joint Direct Attack Munition (JDAM)											
(U) Program Element 0604727F/N, Joint Stand-Off Weapon (JSOW)											
(U) Program Element 0604754F, Joint Tactical Information Distribution System (JTIDS)											
(U) Program Element 0604600F, Wind Corrected Munitions Dispenser (WCMD)											
(U) Program Element 0208006F, Air Force Mission Support System (AFMSS)											
(U) Program Element 604270F, Electronic Warfare (EW) Development											
(U) Program Element 305164F, Global Positioning System (GPS)											

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(U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999					
	1	2	3	4	1	2	3	4	1	2	3	4
DSUP												
(U) Acquisition Milestones												
(U) - Milestone II		*										
(U) Engineering Milestones												
(U) - SFR		*										
(U) - SSR				*								
(U) - PDR						X						
(U) - CDR								X				
(U) T&E Milestones									X			
(U) - Start subsystem qual test									X			
(U) Contract Milestones												
(U) - Award EMD Contract			*									
Mission Planning System												
(U) Engineering Milestones												
(U) - Block E/F PDR									X			
(U) - Block E/F CDR										X		
(U) T&E Milestones											X	
(U) - CMUP JDAM DT&E/IOT&E						X						
(U) - Test Readiness Review/FQT						X						
(U) Contract Milestones												
(U) - Software Delivery												X

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BUDGET ACTIVITY					DATE		PROJECT			
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	FY 1997		FY 1998		FY 1999	
	1	2	3	4	1	2
(U) - Block D Production (GPS/Comm GFE Long Lead) [Lot 1/ LRIP # 1]		*				
(U) - Block D Production (JDAM/1760/ GPS/Comm) [Lot 1/ LRIP # 1]						
(U) - Block D Production (GPS/Comm) (Lot 2)						
(U) - Block D LRIP #2 (JDAM/1760)						
(U) - Block D Production (JDAM/1760) [Lot 1]						
(U) - Block E Delta EMD (JSOW/JASSM)						

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		4596	
5 - Engineering and Manufacturing Development	0604226F B-1B		February 1998	
(U) A. Project Cost Breakdown (\$ in Thousands)				
(U) DSUP	FY 1997	FY 1998	FY 1999	
(U) Risk Reduction/Evaluation	13,757			
(U) EMD	23,555	47,500	61,666	
(U) Mission Planning System				
(U) Contract Funding	9,979	10,047	9,786	
(U) Training Systems				
(U) IVACC Delay II	64			
(U) ACA with Logicon	95			
(U) WST EMD Storage	188			
(U) MTE Computer Rehost	3,118	1,399		
(U) Block D Development	734	4,215	9,058	
(U) Weapons				
(U) Block D (JDAM/GPS/Comm/1760)				
(U) Computer	79,513	40,718	5,100	
(U) WCMD	32,186	43,790	43,632	
(U) JSOW / JASSM	7,858	9,613	9,569	
(U) Data Link Studies	450	7,200	16,957	
(U) Additional CBM Studies	5,239			
(U) Intermediate Wing Sweep Studies	1,000	1,900	200	
		1,995	350	
(U) Government flight test	14,737	21,617	23,451	
(U) GFE	4,483	3,204	930	
(U) ECO		2,632	4,003	
(U) CAAS	3,446	2,920	3,146	
(U) Modeling & Simulation / Studies & Analyses	1,121	1,370	2,500	
(U) OGC/Mission Support	5,863	5,303	5,037	
(U) Pending reprogramming		2,799		
(U) Total	207,386	208,222	195,385	

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE					PROJECT				
5 - Engineering and Manufacturing Development		0604226F B-1B					4596				
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)											
Performing Organizations:											
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Product Development Organizations											
(U) DSUP											
(U) BNA	SS/CPAF	May 93	33,958	33,958	20,201	13,757	0	0	0	33,958	
(U) BNA	SS/CPAF	June 97	218,530	218,530	0	23,555	47,500	61,666	85,809	218,530	
Mission Planning System											
(U) Logicon <sup>1</sup>	CPAF	Aug 94	44,920	44,920	6,718	9,899	9,897	9,636	8,770	44,920	
(U) Lockheed-Martin	CPAF	Dec 95	1,314	1,314	484	80	150	150	450	1,314	
Training Systems											
(U) Lockheed-Martin	C/CPAF	Jun 94	50,911	50,911	3,711	4,199	5,614	9,058	28,329	50,911	
Weapons											
(U) BNA - CBU's	SS/CPFF	93	4,960	4,960	4,960	0	0	0	0	4,960	
(U) BNA - CBU's	SS/CPFF	Jan 94	18,509	18,509	18,509	0	0	0	0	18,509	
(U) BNA-Link 16	TBD	TBD	5,239	5,239	0	5,239	0	0	0	5,239	
(U) BNA-Block D Pre-EMD	SS/CPFF	Aug 93	84,049	84,049	84,049	0	0	0	0	84,049	
(U) BNA-Block D	SS/CPAF	Mar 95	269,654	269,654	144,323	79,513	40,718	5,100	0	269,654	
(U) BNA-CBM	SS/CPAF	TBD	2,100	2,100	0	0	1,900	200	0	2,100	
(U) BNA-Wing Sweep	SS/CPAF	Jul 97	3,345	3,345	0	1,000	1,995	350	0	3,345	
Project 4596		Page 15 of 17 Pages					Exhibit R-3 (PE 0604226F)				

Project 4596

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604226F B-1B

4596

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
(U) BNA- Computer	SS/CPAF	Feb/Jul 97	176,493	176,493	14,101	32,186	43,790	43,632	42,784	176,493
(U) BNA-WCMD	SS/CPAF	Feb/Jul 97	38,686	38,686	2,255	7,858	9,613	9,569	9,391	38,686
(U) Lockheed- Martin / QT	C/CPAF	Jun 94	3,631	3,631	3,631	0	0	0	0	3,631
(U) TBD- JSOW/ JASSM	SS/CPAF	Sep 98	74,922	74,922	218	450	7,200	16,957	50,097	74,922
<u>Support and Management Organizations</u>										
(U) CAAS	Various	Annual	32,276	32,276	11,664	3,446	2,920	3,146	11,100	32,276
(U) Studies & Analyses / Modeling & Sim	Various	Various	26,094	26,094	12,103	1,121	1,370	2,500	9,000	26,094
(U) Mission Support	Various	Various	51,790	51,790	14,715	5,863	5,303	5,037	20,872	51,790
(U) ECO	Various	Various	32,865	32,865	79	0	2,632	4,003	26,151	32,865
(U) Reprogram	N/A	N/A	2,799	2,799	0	0	2,799	0	0	2,799
<u>Test and Evaluation Organizations</u>										
(U) DSUP										
(U) AFFTC	P.O.	Various	66,892	66,892	508	856	3,231	7,581	54,716	66,892
(U) Weapons										
(U) AFFTC	P.O.	Various	108,313	108,313	23,952	13,881	18,386	15,870	36,224	108,313

NOTE: Funded under the AFMSS Program, Program Element 0208006F in FY94 and FY95. Funded under the JDAM program, Program Element 0604618F in FY95.

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604226F B-1B								4596	
(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)											
Government Furnished Property:											
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program		
<u>Product Development Property</u>											
(U) DSUP											
(U) Various	Various	Various	Various	0	3,491	2,310	108	593	6,502		
<u>(U) Training Sys</u>											
(U) Various	Various	Various	Various	0	199	0	0	0	199		
<u>(U) Weapons</u>											
(U) Various	Various	Various	Various	764	793	894	822	817	4,090		
<u>Support and Management Property</u>											
<u>Test and Evaluation Property</u>											
Subtotal Product Development											
				303,924	182,219	171,581	157,248	227,040	1,042,012		
Subtotal Support and Management				38,561	10,430	15,024	14,686	67,123	145,824		
Subtotal Test and Evaluation				24,460	14,737	21,617	23,451	90,940	175,205		
Total Project				366,945	207,386	208,222	195,385	385,103	1,363,041		
Project 4596											
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Project 4596

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PE NUMBER: 0604227F

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PE TITLE: Flight Simulator Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604227F Flight Simulator Development									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		4,241	4,061	1,961	3,904	3,889	3,871	3,854	Continuing	Continuing	
2325 Simulator Development Activities		1,393	1,420	0	0	0	0	0	0	44,068	
2769 Simulator Update Development		2,848	2,641	0	0	0	0	0	0	48,292	
4873 Distributed Mission Training (DMT)		0	0	1,961	3,904	3,889	3,871	3,854	Continuing	Continuing	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

(U) **A. Mission Description and Budget Item Justification:** This is a continuing program element for development of aircrew and maintenance training techniques and devices. Objectives are to adapt simulation technology and standards developed by the laboratories and industry to satisfy MAJCOM training requirements and to develop prototype training devices. This program element is included in Budget Activity 5 - Engineering and Manufacturing Development (EMD) because it is devoted to the EMD of aircrew and maintenance training systems.

(U) **B. Beginning in FY99, Distributed Mission Training (DMT) will become this PE's principal effort.** DMT is an Air Force simulator modernization program that will network geographically-separated, high fidelity aircraft simulators with other battlefield systems (AWACS, JSTARS, C4I, etc.) into a real-time "synthetic battlefield." The envisioned end-state is a virtual network of training systems which will allow "high end" training not possible in today's simulators and very difficult to achieve in the aircraft because of peacetime safety of flight limitations, limited range availability, etc. DMT's focus is to provide a networked combat mission rehearsal training capability to the warfighters at home station. This encompasses dissimilar aircraft simulators being able to practice the necessary critical timing aspects and complex maneuvers for operations such as first air strike packages in future conflicts.

(U) **Acquisition Strategy:** Maximize the use of free and open competitive awards. Mission support efforts use a variety of contract vehicles. Specific programs use contract types appropriate to the work to be performed. Applies to all projects.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget (FY1998 PB)	4,247	4,305	4,422	
(U) Appropriated Value	4,439	4,305		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-117	-204		
b. SBIR	-74	-40		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions	-7			
(U) Adjustments to Budget Years Since FY 1998 PB			-2,461	
(U) Current Budget Submit/1999 President's Budget	4,241	4,061	1,961	Continuing

## (U) Change Summary Explanation:

Funding: Changes in FY97 and FY98 include Congressional/general reductions, SBIR, and rescissions. FY99 and beyond change program direction from generic simulator development and support to Distributed Mission Training (DMT) development. FY98 and beyond reflect inflation rate changes.

Schedule: Projects 2325 and 2769 terminated in FY98.

Technical: FY99 and beyond change program direction from generic simulator development and support to DMT development.

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl cont	Total Cost cont
(U) PE 0207130F, F-15 Squadrons	0	0	23,162	34,687	28,308	31,839	42,184		
Appropriation: O&M, AF									
(U) PE 0207417F, AWACS Squadron	0	0	575	3,519	3,605	3,609	3,707		
Appropriation: O&M, AF									

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	
5 - Engineering and Manufacturing Development		06042227F Flight Simulator Development	

**See individual project R-2 Exhibits for schedule profiles**

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

PROJECT

2325

		COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2325	Simulator Development Activities		1,393	1,420	0	0	0	0	0	0	44,068
	Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

(U) **A. Mission Description and Budget Item Justification:** This project supports engineering development of new aircraft and maintenance training technologies and standards. Funds the pre-production of first article training devices to satisfy the customer's training requirements. Efforts currently planned or underway include evaluation and development of networked multi-ship mission trainer capability using artificial intelligence techniques in the development of a generic Intelligent Training Management System (ITMS) and an evaluation of cutting-edge technology for training will also be developed.

(U) FY 1997 (\$ in Thousands):

(U) 100 Developed visual and radar databases and standards  
 (U) 300 Continued evaluation support for SMART 2000 and visual systems  
 (U) 330 Completed evaluation of improved G-suit/G-seat/sensory simulation capability  
 (U) 304 Continued development of Technology Roadmap  
 (U) 300 Completed subjective transfer training  
 (U) 59 Mission support  
 (U) \$1,393 Total

(U) FY 1998 (\$ in Thousands):

(U) 100 Continue development of visual and radar database and standards  
 (U) 505 Continue evaluation of visual systems  
 (U) 240 Define user training tasks for multi-ship mission training environments  
 (U) 320 Perform long-haul networking studies and analysis  
 (U) 100 Identify and define training device data models and software  
 (U) 100 Continue development of the Technology Roadmap  
 (U) 55 Mission support  
 (U) \$1,420 Total

(U) FY 1999 (\$ in Thousands):

(U) \$0 Total

Project 2325

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

2325

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget (FY1998 PB)	1,393	1,515	1,357	
(U) Appropriated Value	1,461	1,515		
(U) Adjustments to Appropriated Value				
a. Congressional Reductions	-44	-95		
b. SBIR	-24			
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Recissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-1,357	
(U) Current Budget Submit/1999 President's Budget	1,393	1,420	0	44,068

## (U) Change Summary Explanation:

Funding: FY97 & FY98 include Congressional/general reductions and SBIR. FY99 and beyond change program direction from generic simulator development and support to DMT development.

Schedule: Project 2325 terminated effective FY99.

Technical: FY99 and beyond change program direction from generic simulator development and support to DMT development.

(U) C. Other Program Funding Summary (\$ in Thousands): Not Applicable

Project 2325

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

2325

(U) D. Schedule Profile

	FY 1997		FY 1998		FY 1999			
	1	2	3	4	1	2	3	4
(U) SMART 2000 Integration and Documentation				*				
(U) Prototype Training System SMART 2000 and Visual Systems				X				*
(U) Technology Roadmap				X				*
(U) G-Suit/G-Seat Sensory Simulation				X				*
(U) Visual and Radar Database Standards				X				*
(U) Multi-ship Mission Training Environment				X				X
(U) Long-Haul Studies and Analysis								X
(U) Training Device Models and Software								X

X Denotes milestone start

\* Denotes milestone completion

Project 2325

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

2325

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Long-Haul Studies	0	320	0
(U) Visual and Radar Data Standard	100	100	0
(U) Training Device Models and Software	0	100	0
(U) Simulator Training Transfer	300	0	0
(U) SMART 2000 and Visual Systems	300	505	0
(U) Universal Threat Simulator	0	0	0
(U) Technical Support	0	0	0
(U) Technology Roadmap	304	100	0
(U) G-Suit/G-Seat/Sensory Simulation	330	0	0
(U) Multi-Ship Mission Training	0	240	0
(U) Low Cost Helmet-Mounted Display	0	0	0
(U) Network Evaluation	0	0	0
(U) Mission Support	59	55	0
(U) Total	1,393	1,420	0

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations										
Numerous	Various	N/A	N/A	N/A	41,068	1,334	1,365	0	0	43,767

Project 2325

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
2325

## 5 - Engineering and Manufacturing Development

## 0604227F Flight Simulator Development

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget			Total Program
						FY 1997	FY 1998	FY 1999	
<u>Support and Management Organizations</u>									
Training Systems	Various	Various	0	0	187	59	55	0	301
Program Office, ASC, WPAFB									

Test and Evaluation Organizations: Not Applicable

Government Furnished Property: None

Subtotal Product Development	41,068	1,334	1,365	0	0	0	43,767
Subtotal Support and Management	187	59	55	0	0	0	301
Subtotal Test and Evaluation	0	0	0	0	0	0	0
Total Project	41,255	1,393	1,420	0	0	0	44,068

Project 2325

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

BUDGET ACTIVITY		PE NUMBER AND TITLE										DATE	PROJECT																																							
5 - Engineering and Manufacturing Development		0604227F Flight Simulator Development										February 1998	2769																																							
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost																																										
2769	Simulator Update Development	2,848	2,641		0	0	0	0	0	0	48,292																																									
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0																																									
<p>(U) A. <u>Mission Description and Budget Item Justification</u> This project provides critical Training System Product Group (TSPG) support for user commands' products to include F-16 Weapon System Trainer, B-1B conventional upgrade, Simulator for Electronic Combat Training (SECT), C-17 training suite, Universal Training Device, and C-141 Aircrew Training System. These support systems include a computer center, communications, Advisory and Assistance Services (A&amp;AS) contracting, travel, supplies, specialized training, and equipment.</p>																																																				
<p>(U) FY 1997 (\$ in Thousands):</p> <table border="0"> <tr><td>-</td><td>(U)</td><td>485</td><td>Travel</td></tr> <tr><td>-</td><td>(U)</td><td>40</td><td>Communications</td></tr> <tr><td>-</td><td>(U)</td><td>86</td><td>Training</td></tr> <tr><td>-</td><td>(U)</td><td>645</td><td>A&amp;AS</td></tr> <tr><td>-</td><td>(U)</td><td>765</td><td>Management</td></tr> <tr><td>-</td><td>(U)</td><td>383</td><td>Computer Center</td></tr> <tr><td>-</td><td>(U)</td><td>148</td><td>Supplies</td></tr> <tr><td>-</td><td>(U)</td><td>102</td><td>Equipment</td></tr> <tr><td>-</td><td>(U)</td><td>194</td><td>Miscellaneous</td></tr> <tr><td>-</td><td>(U)</td><td>\$2,848</td><td>Total</td></tr> </table>													-	(U)	485	Travel	-	(U)	40	Communications	-	(U)	86	Training	-	(U)	645	A&AS	-	(U)	765	Management	-	(U)	383	Computer Center	-	(U)	148	Supplies	-	(U)	102	Equipment	-	(U)	194	Miscellaneous	-	(U)	\$2,848	Total
-	(U)	485	Travel																																																	
-	(U)	40	Communications																																																	
-	(U)	86	Training																																																	
-	(U)	645	A&AS																																																	
-	(U)	765	Management																																																	
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-	(U)	194	Miscellaneous																																																	
-	(U)	\$2,848	Total																																																	
<p>(U) FY 1998 (\$ in Thousands):</p> <table border="0"> <tr><td>-</td><td>(U)</td><td>526</td><td>Travel</td></tr> <tr><td>-</td><td>(U)</td><td>55</td><td>Communications</td></tr> <tr><td>-</td><td>(U)</td><td>140</td><td>Training</td></tr> <tr><td>-</td><td>(U)</td><td>700</td><td>A&amp;AS</td></tr> <tr><td>-</td><td>(U)</td><td>644</td><td>Management</td></tr> <tr><td>-</td><td>(U)</td><td>195</td><td>Supplies</td></tr> <tr><td>-</td><td>(U)</td><td>147</td><td>Equipment</td></tr> <tr><td>-</td><td>(U)</td><td>234</td><td>Miscellaneous</td></tr> <tr><td>-</td><td>(U)</td><td>\$2,641</td><td>Total</td></tr> </table>													-	(U)	526	Travel	-	(U)	55	Communications	-	(U)	140	Training	-	(U)	700	A&AS	-	(U)	644	Management	-	(U)	195	Supplies	-	(U)	147	Equipment	-	(U)	234	Miscellaneous	-	(U)	\$2,641	Total				
-	(U)	526	Travel																																																	
-	(U)	55	Communications																																																	
-	(U)	140	Training																																																	
-	(U)	700	A&AS																																																	
-	(U)	644	Management																																																	
-	(U)	195	Supplies																																																	
-	(U)	147	Equipment																																																	
-	(U)	234	Miscellaneous																																																	
-	(U)	\$2,641	Total																																																	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

2769

(U) FY 1999 (\$ in Thousands):

- (U) \$0 Total

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget (FY1998 PB)				
(U) Appropriated Value	2,854	2,790	3,065	
(U) Adjustments to Appropriated Value	2,978	2,790		
a. Congressional/General Reductions	-73	-109		
b. SBIR	-50	-40		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions	-7			
(U) Adjustments to Budget Years Since FY 1998 PB			-3,065	
(U) Current Budget Submit/1999 President's Budget	2,848	2,641	0	48,292

## (U) Change Summary Explanation:

Funding: FY97 and FY98 include Congressional/general reductions, SBIR, and rescissions. FY99 and beyond change program direction from generic simulator development and support to Distributed Mission Training (DMT) development.

Schedule: Project 2769 terminated effective FY99.

Technical: FY99 and beyond change program direction from generic simulator development and support to DMT development.

(U) C. Other Program Funding Summary (\$ in Thousands): Not Applicable(U) D. Schedule Profile: Not Applicable. Level of effort task.

Project 2769

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

2769

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Travel	485	526	0
(U) Communications	40	55	0
(U) Training	86	140	0
(U) A&AS	645	700	0
(U) Management	765	644	0
(U) Computer Center	383	0	0
(U) Supplies	148	195	0
(U) Equipment	102	147	0
(U) Miscellaneous	194	234	0
(U) Total	2,848	2,641	0

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations: Not Applicable										

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604227F Flight Simulator Development								2769	
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	
<u>Support and Management Organizations</u>											
Training System Program Office (SPO) ASC, WPAFB OH	Various	Various	N/A	N/A	42,803	2,848	2,641	0	0	48,292	
<u>Test and Evaluation Organizations: Not Applicable</u>											
<u>Government Furnished Property: None</u>											
Subtotal Product Development					0	0	0	0	0	0	
Subtotal Support and Management					42,803	2,848	2,641	0	0	48,292	
Subtotal Test and Evaluation					0	0	0	0	0	0	
Total Project					42,803	2,848	2,641	0	0	48,292	

Project 2769

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Project 2769

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604227F Flight Simulator Development

4673

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4673 Distributed Mission Training (DMT)	0	0	1,961	3,904	3,889	3,871	3,854	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification. Distributed Mission Training (DMT) will revolutionize air and space team training by implementing a "train the way you fight" philosophy. This program will allow the Air Force to conduct full mission training, which can only be done to a limited extent today due to constraints on flying hours, platform and airspace availability, and environmental constraints. DMT will network geographically-separated aircraft simulators, C4I assets, and other battlefield systems and trainers in a "synthetic battlefield environment." DMT operations will be conducted using Operations and Maintenance funds. Engineering Development efforts will focus on development, demonstration, and transitioning of enhancements of critical functions associated with the DMT network and linked simulators. Areas of emphasis include development and demonstration of network architectures, common databases and database interfaces, improved simulator fidelity, and integration with constructive simulations for C4I. The ultimate objective of the program is to expand DMT to be able to conduct full joint and combined forces mission rehearsals.

(U) FY 1997 (\$ in Thousands):  
 - (U) \$0 Total

(U) FY 1998 (\$ in Thousands):  
 - (U) \$0 Total

(U) FY 1999 (\$ in Thousands):  
 - (U) 961 Development and implementation of the DMT network to include standards development, multilevel security and latency management approaches, integration of dissimilar aircraft, command and control systems, intel systems, constructive model simulators, and legacy systems  
 - (U) 500 Development and integration of a common network database architecture, and implementation of database interfaces  
 - (U) 500 Demonstration and testing of technologies to improve image generation fidelity across the DMT network  
 - (U) \$1,961 Total

Project 4673

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998				
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT					
5 - Engineering and Manufacturing Development		0604227F Flight Simulator Development		4673					
(U) B. <u>Program Change Summary (\$ in Thousands)</u>									
(U) Previous President's Budget (FY1998 PB)	FY 1997	FY 1998	FY 1999	Total					
(U) Appropriated Value	0	0	0	Cost	0				
(U) Adjustments to Appropriated Value									
a. Congressional/General Reductions									
b. SBIR									
c. Omnibus or Other Above Threshold Reprogram									
d. Below Threshold Reprogramming									
e. Rescissions									
(U) Adjustments to Budget Years Since FY 1998 PB			1,961						
(U) Current Budget Submit/1999 President's Budget	0	0	1,961	Continuing					
(U) Change Summary Explanation:									
Funding: FY99 funding initiates DMT program.									
Schedule: N/A									
Technical: N/A									
(U) C. <u>Other Program Funding Summary (\$ in Thousands): N/A</u>									
(U) PE 0207130F, F-15 Squadrons	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To	Total
Appropriation: O&M, AF	0	0	23,162	34,687	28,308	31,839	42,184	Compl	Cost
(U) PE 0207417F, AWACS Squadron								cont	cont
Appropriation: O&M, AF	0	0	575	3,519	3,605	3,609	3,707	cont	cont
Project 4673									
Page 14 of 17 Pages									
Exhibit R-2 (PE 0604227F)									

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998	
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT		
5 - Engineering and Manufacturing Development	0604227F Flight Simulator Development	4673		
<u>(U) D. Schedule Profile</u>				
(U) F-15 Four Ship Operations begin at Eglin AFB		FY 1997	FY 1998	FY 1999
		1 2 3 4 1 2 3 4 1 2 3 4		
(U) F-15 Four Ship Operations begin at Langley AFB				X
(U) DMT Integration & Operations begin				X
(U) AWACS ops begin :Tinker AFB, OK				X

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

## Development

## PROJECT

**4673**

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) DMT Network Architecture Development	0	0	961
(U) Common database and interface integration	0	0	500
(U) Demonstration of improved simulator/network fidelity	0	0	500
(U) Total	0	0	1,961

(U) **B. Budget Acquisition History and Planning Information (\$ in Thousands)**

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding or <u>Vehicle</u>	Award or Obligation <u>Date</u>	Performing Activity <u>EAC</u>	Project Office <u>EAC</u>	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Total Program
----------------------------------------------	---------------------------------------------------	---------------------------------	--------------------------------	---------------------------	------------------------	----------------	----------------	----------------	---------------

## Product Development Organizations

TBD	CPAF/FPAT (for development)	Jun 99 (estimated)	TBD	TBD	0	0	1,761	continuing	continuing
	FFP/FPAT (for operations)								

## Support and Management Organizations

Training Systems Product Group	N/A	0	0	200	continuing	continuing
Training Systems	N/A	0	0	200	continuing	continuing

Project 4673

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

BUDGET ACTIVITY		DATE	PROJECT
5 - Engineering and Manufacturing Development		February 1998	4673
PE NUMBER AND TITLE		0604227F Flight Simulator Development	

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)										
Test and Evaluation Organizations: Not Applicable										
Government Furnished Property: Not Applicable										
Subtotal Product Development					0	0	0	1,761	continuing	continuing
Subtotal Support and Management					0	0	0	200	continuing	continuing
Subtotal Test and Evaluation					0	0	0	0	0	0
Total Project					0	0	0	1,961	continuing	continuing

Project 4673

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PE NUMBER: 0604233F

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PE TITLE: Specialized Undergraduate Pilot Trng

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604233F Specialized Undergraduate Pilot Trng									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		63,975	67,866	55,563	35,759	22,280	1,937	2,035	0	332,233	
4102 Joint Primary Aircraft Training System (JPATS)		41,091	54,890	44,373	34,218	22,280	1,937	2,035	0	268,693	
4376 T-38 Avionics Upgrade program (AUP)		22,884	12,976	11,190	1,541	0	0	0	0	63,540	
Quantity of RDT&E Articles		*2/12,700	0	0	0	0	0	0	0	*4/174,271	

(U) \* Note: The quantity of RDT&E articles shown above includes two T-38 AUP aircrew training devices (\$12,700K in FY97). It also includes the JPATS test aircraft (T-1) funded with FY95 through FY00 funds and one set of Ground Based Training System (GBTS) simulators funded with FY97 through FY01 funds (\$161,571K total).

(U) A. Mission Description and Budget Item Justification

Supports Air Education and Training Command's (AETC) implementation of Specialized Undergraduate Pilot Training (SUPT) and the Department of Defense initiative for joint pilot training. The Joint Primary Aircraft Training System (JPATS) is a joint USAF/USN venture to replace the Services' fleets of primary trainer aircraft (T-37 and T-34 respectively) and associated Ground Based Training Systems (GBTS). The Air Force is the Executive Service. The T-38 Avionics Upgrade Program (AUP) is an integrated modernization of the T-38 and AT-38 cockpits to support mission ready bomber/fighter training. This program is in Budget Activity 5, Engineering and Manufacturing Development, because it primarily involves the missionization of commercial derivative aircraft, equipment, and components.

(U) Acquisition Strategy:

Each acquisition has been competitively awarded with the intent of maximizing the use of commercially available equipment and best commercial practices. The JPATS Program competitively awarded two contracts: a firm fixed price contractor logistics support (CLS) contract and a fixed price incentive firm manufacturing development (MD)/production contract with seven options. The T-38 AUP competitively awarded three contracts to a single prime: a) a cost plus award fee EMD contract with six firm fixed price production options; b) a firm fixed price CLS contract for avionics including Contractor Owned and Maintained Base Supply (COMBS); and c) a fixed price award fee maintenance contract for the current and new Aircrew Training Devices (ATDs).

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY1998 PB)	75,680	80,238	67,183	401,578
(U) Appropriated Value	79,260	72,238		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,682	-2,675		
b. SBIR	-1,898	-1,697		
c. Omnibus or Other Above Threshold Reprogram	-11,575			
d. Below Threshold Reprogramming				
e. Rescissions	-130			
(U) Adjustments to Budget Years Since FY1998 PB			-11,620	
(U) Current Budget Submit/1999 President's Budget	63,975	67,866	55,563	332,233

## (U) Change Summary Explanation:

Funding: FY97 and FY98 include Congressional/general reductions, SBIR, reprogrammings, and rescissions. JPATS adjustments in FY99 are based on Ground Based Training System (GBTS) contractor cost proposals that were lower than anticipated and to Air Force funding availability. JPATS "to complete" funding decreases due to a shift of mission support costs from RDT&E to Aircraft Procurement. FY99 T-38 AUP is increased for higher than anticipated contractor and Flight Test Center cost. FY99 and "to complete" reflect inflation rate changes.

Schedule: JPATS first flight slipped from Mar to May 98 due to manufacturing process delays. Air Force acceptance (DD 250) of JPATS aircraft T-1 will slip as well. As a result of FY99 funding reductions, JPATS Training Integration Management System (TIMS) development is impacted, which causes Air Force Milestone III to slip to 2QFY00.

Technical: N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604233F Specialized Undergraduate Pilot Trng									
(U) C. Other Program Funding Summary (\$ in Thousands)											
		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost	
(U)	Aircraft Procurement, Air Force										
	JPATS, BA-3	66,866	75,878	107,086	85,500	100,561	217,437	255,035	663,500	1,670,063	
	JPATS, BA-6							62,511	59,607	122,118	
(U)	Military Construction, Air Force										
	PE 0804741F, JPATS	0	2,470	0	3,200	0	0	3,200	7,700	16,570	
(U)	RDT&E, Navy, BA-7										
	PE 0603208N, Training System Aircraft, H1150, JPATS	1,834	391	595	316	0	0	0	0	11,531	
(U)	Aircraft Procurement, Navy										
	JPATS, BA-3	0	0	0	33,294	80,104	81,452	83,359	1,373,700	1,651,909	
	APN 6 Spares	0	0	0	0	0	0	21,642	128,100	149,742	
(U)	Military Construction, Navy	0	0	0	9,300	1,500	600	1,300	11,617	24,317	
(U)	Aircraft Procurement, Air Force										
	T-38 Avionics Upgrade, BP1100	0	0	38,068	95,684	92,349	87,025	105,138	168,927	587,191	
(U) D. Schedule Profile											
See individual project R-2 Exhibits for schedule profiles											
Exhibit R-2 (PE 0604233F)											

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

PROJECT

4102

		COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4102	Joint Primary Aircraft Training System (JPATS)		41,091	54,890	44,373	34,218	22,280	1,937	2,035	0	268,693
	Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	2*\$/161,571

\* Note: JPATS test aircraft (T-1) funded with FY95 through FY00 funds and one set of Ground Based Training System (GBTS) simulators funded with FY97 through FY01 funds (\$161,571K total).

(U) A. Mission Description and Budget Item Justification

The Joint Primary Aircraft Training System (JPATS) is a joint USAF/USN venture to replace the Services' fleets of primary trainer aircraft (T-37 and T-34, respectively) and associated Ground Based Training Systems (GBTS). The aircraft and GBTS will be used to train entry-level student aviators in the fundamentals of flying so they can transition into advanced tracks leading to qualification as military pilots, navigators, and naval flight officers. The program includes the purchase of aircraft, simulators, and other associated ground-based training devices, training integration management systems, instructional courseware, and logistics support. Funding reflects the requirements of the May 96 (Rev 1) Operational Requirements Document. In Jun 95, Raytheon (Beech) Aircraft was selected as the aircraft prime contractor. Resolution of protests and contract award occurred in Feb 96.

## (U) FY 1997 (\$ in Thousands):

(U) 27,532 Continued first aircraft development and complete aircraft Critical Design Review (CDR)  
 (U) 5,524 Modified contract to support GBTS development  
 (U) 925 Continued flight test program  
 (U) 7,110 Other Government costs  
 (U) \$41,091 Total

## (U) FY 1998 (\$ in Thousands):

(U) 17,441 Continue first aircraft development  
 (U) 26,643 Continue Ground Based Training System (GBTS) development  
 (U) 2,100 Continue flight test program  
 (U) 8,706 Other Government costs  
 (U) \$54,890 Total

Project 4102

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

4102

## (U) FY 1999 (\$ in Thousands):

- (U) 6,543 Deliver Manufacturing Development aircraft (T-1)  
 - (U) 34,162 Continue GBTS development and complete GBTS CDR  
 - (U) 100 Complete flight test program  
 - (U) 3,568 Other Government costs  
 - (U) \$44,373 Total

## (U) B. Program Change Summary (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	Total Cost
(U) Previous President's Budget (FY1998 PB)	52,796	63,388	58,267	336,400
(U) Appropriated Value	55,300	58,388		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,179	-2,126		
b. SBIR	-1,325	-1,372		
c. Omnibus or Other Above Threshold Reprogram	-11,575			
d. Below Threshold Reprogramming				
e. Rescissions	-130		-13,894	
(U) Adjustments to Budget Years Since FY1998 PB	41,091	54,890	44,373	268,693
(U) Current Budget Submit/1999 President's Budget				

## (U) Change Summary Explanation:

Funding: FY97 and FY98 include Congressional/general reductions, SBIR, reprogrammings, and rescissions. JPATS adjustments in FY99 are based on Ground Based Training System (GBTS) contractor cost proposals that were lower than anticipated and to Air Force funding availability. JPATS "to complete" funding decreases due to a shift of mission support costs from RDT&E to Aircraft Procurement. FY99 and "to complete" reflect inflation rate changes.

Schedule: JPATS first flight slipped from Mar to May 98 due to manufacturing process delays. Air Force acceptance (DD 250) of JPATS aircraft T-1 may slip five months. As a result of FY99 funding reductions, JPATS Training Integration Management System (TIMS) is impacted, which may cause Air Force Milestone III to slip to 2QFY00.

Technical: N/A

Project 4102

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

4102

(U) C. Other Program Funding Summary (\$ in Thousands)(U) Aircraft Procurement, Air Force, BA-3

JPATS

JPATS, BA-6

(U) Military Construction, Air Force

PE 0804741F, JPATS

(U) RDT&E, Navy, BA-7PE 0603208N, Training System Aircraft,  
H1150, JPATS(U) Aircraft Procurement, Navy, BA-3

JPATS

APN 6 Spares

(U) Military Construction, Navy

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
	66,866	75,878	107,086	85,500	100,561	217,437	255,035	663,500	1,670,063
							62,511	59,607	122,118
	0	2,470	0	3,200	0	0	3,200	7,700	16,570
	1,834	391	595	316	0	0	0	0	11,531
	0	0	0	33,294	80,104	81,452	83,359	1,373,700	1,651,909
	0	0	0	0	0	0	21,642	128,100	149,742
	0	0	0	9,300	1,500	600	1,300	11,617	24,317

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

4102

(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Aircraft Missionization/Test and Evaluation	28,457	19,541	6,643
(U) Ground Based Training System (GBTS)	5,524	26,643	34,162
(U) Other Government Costs (OGC)	7,110	8,706	3,568
(U) Total	41,091	54,890	44,373

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

## Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Raytheon Aircraft Company (RAC)	C/FPF	5 Feb 96	162,300	175,500	54,723	28,457	19,541	6,643	495	109,859*
Flight Safety Services Corp.	N/A**	26 Sep 97	N/A***	N/A***	400	5,524	26,643	34,162	52,587	119,316*
<u>Support and Management Organizations</u>										
Various	Various	Various	N/A	N/A	12,746	7,110	8,706	3,568	7,388	39,518

Test and Evaluation Organizations: Not Applicable

\* RAC contract Total Program includes contract "to ceiling", Engineering Change Order (ECO), and Award Fee

\*\* Subcontract to RAC

\*\*\* RAC EAC includes subcontracted GBTS effort and is not individually reported.

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

4102

## (U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

Government Furnished Property: None

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total				Total Program	
				Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999		Budget to Complete
Subtotal Product Development				55,123	33,981	46,184	40,805	53,082	229,175
Subtotal Support and Management				12,746	7,110	8,706	3,568	7,388	39,518
Subtotal Test and Evaluation				0	0	0	0	0	0
Total Project				67,869	41,091	54,890	44,373	60,470	268,693

Project 4102

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604233F Specialized Undergraduate Pilot Trng								4376	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4376	T-38 Avionics Upgrade program (AUP)	22,884	12,976	11,190	1,541	0	0	0	0	63,540	
Quantity of RDT&E Articles		2/\$12,700	0	0	0	0	0	0	0	2/\$12,700	

(U) A. Mission Description and Budget Item Justification  
 The T-38 Avionics Upgrade Program (AUP) is an integrated modernization of the T-38 and AT-38 cockpits to support mission-ready bomber and fighter training. The modernized digital cockpit will include Global Positioning System (GPS), Head-Up Display (HUD), Inertial Navigation System (INS), Multi-Function Displays (MFDs), Data Transfer System (DTS), No-Drop Bombing System (NDBS), and Hands-On Throttle and Stick (HOTAS) switchology. HUD symbology will be the new USAF standard recently certified as a primary flight reference. Also included is the acquisition of two types of Aircrew Training Devices (ATDs) to replace the existing T-51 simulators. The program includes the design, integration, test, and installation of the cockpit prototype in aircraft, ATDs, and other training devices.

(U) FY 1997 (\$ in Thousands):  
 - (U) 22,884 Continue EMD phase - conduct System Requirement Review; complete demonstrations and studies; develop software; software and system integration and contractor testing; conduct System/Software Design Reviews; complete air vehicle Initial and Final Design Reviews  
 - (U) \$22,884 Total

(U) FY 1998 (\$ in Thousands):  
 - (U) 12,976 Continue EMD phase; complete modification of EMD aircraft numbers one and two; complete contractor testing; complete integration first flight; conduct DT&E/IOT&E; perform production planning; perform manufacturing lineproofing; conduct ATD design reviews; start ATD CLS and Training Software Support Center (TSSC) site assessments; start ATD testing  
 - (U) \$12,976 Total

(U) FY 1999 (\$ in Thousands):  
 - (U) 11,190 Complete government flight test; conduct Functional Configuration Audit (FCA); conduct Production Readiness Review (PRR); obtain production Milestone II approval; continue Aircrew Training Device (ATD) Contractor Logistics Support (CLS) and Avionics Support (AVS) Contractor Owned and Maintained Base Supply (COMBS) planning; build ATD prototypes and continue ATD testing; complete Training Software Support Center (TSSC) delivery  
 - (U) \$11,190 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
5 - Engineering and Manufacturing Development		4376	
(U) B. Program Change Summary (\$ in Thousands)		0604233F Specialized Undergraduate Pilot Trng	
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY1998 PB)	22,884	16,850	8,916
(U) Appropriated Value	23,960	13,850	
(U) Adjustments to Appropriated Value			
a. Congressional/General Reductions	-503	-549	
b. SBIR	-573	-325	
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming			
e. Rescissions			
(U) Adjustments to Budget Years Since FY1998 PB			2,274
(U) Current Budget Submit/1999 President's Budget	22,884	12,976	11,190
(U) Change Summary Explanation:			
Funding: FY97 and FY98 include Congressional/general reductions and SBIR. FY99 is increased for higher than anticipated contractor and Flight Test Center cost proposal estimates. FY99 and "to complete" reflect inflation rate changes.			
Schedule:	N/A		
Technical:	N/A		
Total Cost 65,178			

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

PROJECT

4376

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, Air Force									
PE 0804741F, T-38 Avionics Upgrade,	0	0	38,068	95,684	92,349	87,025	105,138	168,927	587,191
BP 1100									

## (U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 1999
1	2	3	4	1	2	3	4	
*								

(U) System Requirements Review

(U) Complete Test and Evaluation Master Plan

(U) Air Vehicle Initial Design Review

(U) Air Vehicle Final Design Review

(U) ATD Initial Design Review

(U) ATD Final Design Review

(U) First Flight

(U) DT&amp;E Complete

(U) IOT&amp;E Complete

(U) Functional Configuration Audit

(FCA)

(U) Milestone III Production Decision

(U) First Production ATD Delivered

(1QFY00)

(U) First Production Aircraft Delivered

(2QFY00)

\* Denotes completed milestone

Project 4376

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Exhibit R-2 (PE 0604233F)

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604233F Specialized Undergraduate Pilot Trng

4376

## (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Avionics System Upgrade	13,143	3,946	1,794
(U) Aircrew Training Devices	3,065	3,885	1,397
(U) System Engineering/Program Management	2,125	1,750	1,118
(U) System Test and Evaluation	346	600	1,178
(U) Training	58	80	95
(U) EMD Data	94	90	234
(U) Mission Support Equipment	147	4	0
(U) Maintenance Support Equipment	6	2	0
(U) Award Fee	900	900	1,000
(U) Other Government Costs	3,000	1,719	4,374
(U) Total	22,884	12,976	11,190

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Organizations										
McDonnell Douglas ASC/TAA WPAFB OH	C/CPAF	31 Jul 96	47,336	48,800	12,549	18,984	9,280	5,695	1,541	48,049
	Various	Annual	N/A	N/A	2,084	2,917	2,620	4,520	0	12,141

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)						DATE	PROJECT						
BUDGET ACTIVITY													
5 - Engineering and Manufacturing Development						0604233F Specialized Undergraduate Pilot Trng	4376						
PE NUMBER AND TITLE													
<u>Support and Management Organizations</u>													
SA-ALC/LF	Various	Quarterly	N/A	N/A	225	152	80	0	537				
Kelly AFB TX													
AETC Randolph AFB TX	Various	Quarterly	N/A	N/A	1	108	80	0	279				
OO-ALC/LIR	Various	Quarterly	N/A	N/A	90	250	130	0	670				
Ogden AFB UT													
<u>Test and Evaluation Organizations</u>													
445 FLTS	PO	Annual	N/A	N/A	0	395	608	205	0	1,208			
Edwards AFB CA													
AFOTEC	PO	Annual	N/A	N/A	0	78	178	400	0	656			
Kirtland AFB NM													
<u>Government Furnished Property: None</u>													
Subtotal Product Development								14,633	21,901	11,900	10,215	1,541	60,190
Subtotal Support and Management								316	510	290	370	0	1,486
Subtotal Test and Evaluation								0	473	786	605	0	1,864
Total Project								14,949	22,884	12,976	11,190	1,541	63,540

Project 4376

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Exhibit R-3 (PE 0604233F)

Project 4376

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Exhibit R-3 (PE 0604233F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY										PROJECT	
5 - Engineering and Manufacturing Development										4069	
PE NUMBER AND TITLE										0604239F F-22 EMD	
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
4069 Advanced Tactical Fighter - FSD	1,888,985	1,958,915	1,582,217	1,204,490	995,191	811,092	221,494	0	22,663,988		
Quantity of RDT&E Articles	1	1	1	3	3	0	0	0	9*		

\*Unit cost of RDT&E articles not separately priced.

Note: - FY97 funding that was in PE27219F for Out of Production Parts (OPP) was moved to PE 64239F Project 4772 for FY97 only; Funding for OPP in FY98-FY01 is in Project 4069.

- Total Cost includes \$3,779,811,000 of Demonstration and Validation funding prior to FY92 funded in PE 0603230F

(U) A. Mission Description and Budget Item Justification

The F-22 is designed to penetrate enemy airspace and achieve a first look, first kill capability against multiple targets. The F-22 is characterized by a low observable, highly maneuverable airframe, advanced integrated avionics, and aerodynamic performance that allows supersonic cruise without the use of afterburner. The F-22 is currently in the Engineering and Manufacturing Development (EMD) phase of acquisition and plans to release long lead production funding for Lot 1 aircraft in FY98.

The EMD phase effort consists of:

- Design, development, fabrication, test and delivery of nine flight test vehicles and two ground test vehicles (static and fatigue).
- Design, development, fabrication, and delivery of 26 flight qualified engines.
- Design, development, fabrication, integration, and test of the EMD avionics suite including air-to-surface provision.
- Updating the YF-22 Avionics Flying Laboratory with EMD assets and software to become a Flying Test Bed (FTB) to support avionics integration.
- Design, development, and test of F-22 weapons system support and training system.

This program is in Budget Activity 5, Engineering and Manufacturing Development, because the F-22 Program is developing the next-generation air superiority fighter for the USAF to counter emerging worldwide threats.

(U) Acquisition Strategy: The EMD contract is Cost Plus Award Fee with Lockheed Martin Aeronautical Systems (LMAS) and Pratt & Whitney (P&W) to produce the F119 engines. The engines are provided to LMAS as Government Furnished Equipment (GFE).

Note:

The F-22 EMD program is currently Congressionally capped at \$18,688M. Efforts are underway to adjust the cap upward by \$352.6M for OPP redesign efforts bringing the adjusted cap to \$19,040.6.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT 4069	
5 - Engineering and Manufacturing Development	0604239F F-22 EMD		
(U) FY 1997 (\$ in Thousands):			
- (U) \$964,348	Air Vehicle		
	- Completed assembly of Engineering and Manufacturing Development (EMD) aircraft #1. (NSP)		
	- Continued assembly of EMD aircraft #2. (NSP)		
	- Initiated assembly of EMD aircraft #3. (NSP)		
	- Conducted Interim Production Readiness Review (PRR). (NSP)		
	- Conducted First Flight Readiness Review (FRR). (NSP)		
	- Conducted F-22 first flight. (NSP)		
	- Began installation systems on Flying Test Bed (FTB) (NSP)		
	- Initiated structural modification of Flying Test Bed (FTB). (NSP)		
	- Initiated assembly of static article. (NSP)		
	- Initiated assembly of fatigue article. (NSP)		
	- Tech order data for First Development Test & Evaluation (DT&E) aircraft available. (NSP)		
	- Integrated Maintenance Information System (IMIS) for flight test available. (NSP)		
	- Supply Support Provisioning Management System implemented. (NSP)		
	- Completed initial supportability assessment. (NSP)		
	- Continued full scale pole model testing (RCS) (NSP)		
- (U) \$628,281	Avionics		
	- Completed mission software Block 1 Computer Software Component (CSC) integration. (NSP)		
	- Continued Avionics Integration Laboratory (AIL) integration in preparation of Block 1 integration testing. (NSP)		
	- Initiated FTB modifications, fabrication, and installation, conducted air worthiness review. (NSP)		
	- Continued mission software Block 2 coding and unit test. (NSP)		
	- Initiated Diminishing Manufacturing Sources (DMS) redesign activities for production incorporation. (NSP)		
- (U) \$211,356	Engine		
	- Completed initial flight test engine qualification testing. (NSP)		
	- Delivered and support five flight test engines. (NSP)		
	- Began verification of engine support system products. (NSP)		
	- Continued engine development test program and initiate production engine configuration testing. (NSP)		
	- Added one ground test engine (8 total) (NSP)		
	- Continued to build and test additional flight test engines (NSP)		

Project 4069

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Exhibit R-2 (PE 0604239F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE		
5 - Engineering and Manufacturing Development	0604239F F-22 EMD		4069
- (U) \$85,000	Other Government Cost		
	- Flight test support at Edwards AFB.		
	- Continued support of engine testing.		
	- Continued sled test program at Holloman AFB.		
	- Further phase II aperture measurements at Rome Labs.		
	- Additional stores separation wind tunnel testing at AEDC.		
	- Mission support of the SPO; travel, computer costs, training, communications, misc contracts, etc.		
	- Procurement of required government furnished equipment (GFE).		
	- Avionics ground testing at various government test facilities		
	- Continued live fire testing at Wright Labs		
- (U) \$1,888,985	Total		
(U) FY 1998 (\$ in Thousands):			
- (U) \$1,165,046	Air Vehicle		
	- Complete assembly of Engineering and Manufacturing Development (EMD) aircraft #2. (NSP)		
	- Continue assembly of EMD aircraft #3. (NSP)		
	- Initiate assembly of EMD aircraft # 4-6. (NSP)		
	- Continue systems installations on Flying Test Bed (FTB) (NSP)		
	- Continue full scale pole model testing (RCS) (NSP)		
	- Continue flight test and flight test support (NSP)		
- (U) \$452,160	Avionics		
	- Begin Avionics Integration Laboratory (AIL) Block 1 integration (NSP)		
	- Continue incorporating Avionics hardware into the FTB (NSP)		
	- Begin AIL integration in preparation of Block 2 integration testing (NSP)		
	- Begin delivery and installation of avionics hardware on the first avionics test aircraft (NSP)		
	- Continue DMS redesign activities for production incorporation (NSP)		
	- Initiate FTB flight testing. (NSP)		
- (U) \$208,909	Engine		
	- Continue production engine configuration development testing (NSP)		
	- Continue to deliver and support three additional flight test engines (8 total) (NSP)		
	- Continue verification of engine support system products (NSP)		
	- Continue to build and test additional flight test engines (NSP)		

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604239F F-22 EMD

4069

- (U) \$132,800 Other Government Cost

- Flight test and flight test support at Edwards AFB
- Continued support of engine testing
- Continue stores separation testing at AEDC
- Continue sled test program at Holloman AFB
- Continue aperture measurements at Rome Labs
- Avionics ground testing at various government test facilities
- Mission support of the SPO; travel, computer costs, misc contracts, etc.
- Procurement of required government furnished equipment (GFE)
- Continue Live Fire testing at Wright Labs

- (U) \$1,958,915 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$826,696 Air Vehicle

- Complete assembly of EMD aircraft #3 . (NSP)
- Continue assembly of EMD aircraft #4-6. (NSP)
- Initiate assembly of EMD aircraft #7-9. (NSP)
- Conduct First Flight Readiness Review (FRR) for aircraft #4. (NSP)
- Begin static test. (NSP)
- Begin fatigue test. (NSP)
- Complete full scale pole model testing (RCS) (NSP)
- Continue flight test and flight test support (NSP)

- (U) \$461,831 Avionics

- First flight of the first avionics test aircraft (NSP)
- Continue flight testing avionics on the FTB (NSP)
- Complete Avionics Integration Laboratory (AIL) Block 1 integration (NSP)
- Begin AIL Block 3 integration (NSP)

- Continue DMS redesign, requalification and retesting activities (NSP)

Engine

- (U) \$174,490

- Continue to deliver and support eleven additional flight test engines (19 total) (NSP)
- Continue verification of engine support system products (NSP)
- Continue building and testing flight test engines (NSP)
- Initiate qualification testing of production engine configuration (NSP)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604239F F-22 EMD

4069

- (U) \$119,200 Other Government Cost
- Flight test and flight test support at Edwards AFB
  - Continued support of engine testing at AEDC
  - Completion of aperture measurements at Rome Labs
  - Continue avionics ground testing at various government facilities
  - Mission support of the SPO; travel, computer costs, misc contracts, etc.
  - Procurement of required government furnished equipment (GFE)
  - Continue sled test program at Holloman AFB
  - Continue live fire testing at Wright Lab
  - Completion of stores separation testing at AEDC
- (U) \$1,582,217 Total

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998PB)	1,818,462	2,071,234	1,464,782	22,398,214
(U) Appropriated Value	1,906,021	2,077,234		
(U) Adjustments to Appropriated Value				
a. General Congressional Reductions	-39,906	-68,250		
b. SBIR	-47,653	-50,069		
c. Omnibus & Other Above Threshold Reprogramming	73,531			
d. BTR				
e. Rescission	-3,008			
(U) Adjustments to Budget Years Since FY98 PB			117,435	
(U) Current Budget Submit/FY99 President's Budget (PB)	1,888,985	1,958,915	1,582,217	22,663,988

## (U) Change Summary Explanation:

## Funding:

- The FY97 appropriated value was increased by \$73.531M as a result of a reprogramming from the 3010 appropriation for OPP redesign efforts.
- The adjustments to budget years since the FY98 PB include transfers from aircraft procurement for out-of-production parts redesigns and operations & maintenance for lab infrastructure costs. An adjustment in inflation assumptions also was included.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

PE NUMBER AND TITLE

**0604239F F-22 EMD**

4069

**Technical: None**

(U) C. Other Program Funding Summary (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>Complete</u>	<u>To</u>	<u>Total</u>
(U) Military Construction (PE 0604239F)	4,390	0	0	0	0			0		**21,040
(U) Military Construction (PE 0207219F)	0	0	0	16,400	17,300	17,300	9,800	190,400		251,200
(U) Aircraft Procurement (PE 0207219F)	7,481	73,188	813,814	1,546,828	2,409,369	3,100,715	4,264,526	30,388,007		42,603,928

**\*\* Includes \$16,650 of FY96 & prior funds.**

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
BUDGET ACTIVITY		PE NUMBER AND TITLE						DATE	PROJECT
5 - Engineering and Manufacturing Development		0604239F F-22 EMD						February 1998	4069
(U) D. <u>Schedule Profile</u>									
		FY 1997		FY 1998		FY 1999			
		1	2	3	4	1	2	3	4
(U) Aircraft Delivered (EMD Test Article)					X				
Program Milestones									
- DAB Review LRIP LL									
- DAB MS III, 4QFY03									
Engineering Milestones									
- First Flight									
- Final PRR, 4QFY00									
- First Avionics Flight									
T&E Milestones									
- DT&E First Flight									
- Dedicated IOT&E, 4QFY02									
EMD = Engineering & Manufacturing Development, DAB = Defense Acquisition Board, LRIP = Low Rate Initial Production, LL = Long Lead, MS = Milestone, DT&E = Developmental Test & Evaluation, IOT&E = Initial Operational Test & Evaluation									

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
5 - Engineering and Manufacturing Development		0604239F F-22 EMD		4069	
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>					
		<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	
(U) Air Vehicle/Avionics		1,592,629	1,617,206	1,288,527	
(U) Engine		211,356	208,909	174,490	
(U) Government Cost					
- Government Test		61,600	75,300	78,500	
- Mission Support		13,700	14,500	14,000	
- HAZMAT		500	25,000	23,000	
- GFE		9,200	18,000	3,700	
(U) Total		1,888,985	1,958,915	1,582,217	
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u>					
Performing Organizations:					
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997
					<u>FY 1997</u>
					<u>Budget</u>
					<u>FY 1998</u>
					<u>Budget</u>
					<u>FY 1999</u>
					<u>Budget to</u>
					<u>Complete</u>
					<u>Program</u>
<u>Product Development Organizations</u>					
Lockheed (Air Veh)	C/CPAF	Aug 91	12,475,239	15,206,226	8,306,104
				1,592,629	1,617,206
					1,288,527
					2,413,678
					15,218,144
Pratt & Whitney	C/CPAF	Aug 91	2,194,010	2,480,423	1,619,589
				211,356	208,909
					174,490
					267,489
					2,481,833
<u>Support and Management Organizations</u>					
Support Contracts	Various	Various	N/A	8,155	2,000
In House Support	Various	Various	N/A	59,845	12,200
				12,253	27,247
				25,303	31,800
				11,697	48,200
					94,505
					144,195
Project 4069					
Exhibit R-3 (PE 0604239F)					

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

0604239F F-22 EMD

PROJECT  
4069

## 5 - Engineering and Manufacturing Development

Contract or

Government

Performing

Activity

Contract

Method/Type

or Funding

Vehicle

Award or

Obligation

Date

Performing

Activity

EAC

Project

Office

EAC

Total

Prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

## Test and Evaluation Organizations

AEDC

PO

N/A

N/A

N/A

67,500

19,900

18,400

10,700

10,200

126,700

AFMTC

PO

N/A

N/A

N/A

71,500

34,900

43,300

59,500

454,800

664,000

All Other Tests

Various

N/A

N/A

N/A

65,900

6,800

13,600

8,300

1,200

95,800

\* Note: The Project Office EAC includes the following items not included in the Performing Activity (i.e. Contractor) EAC - Base Fee, Award Fee, SPO Planned CCPs not yet on contract, and other adjustments based on results of the restructured program.

## Government Furnished Property:

Contract

Method/Type

or Funding

Vehicle

Award or

Obligation

Date

Delivery

Date

Total

Prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

## Product Development Property

Various

Various

Various

23,200

9,200

18,000

3,700

4,900

59,000

## Support and Management Property

N/A

N/A

0

0

0

0

0

0

## Test and Evaluation Property

N/A

N/A

0

0

0

0

0

0

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604239F F-22 EMD

PROJECT

4069

Item Description	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	9,948,893	1,813,185	1,844,115	1,466,717	2,686,067	17,758,977
Subtotal Support and Management	68,000	14,200	39,500	37,000	80,000	238,700
Subtotal Test and Evaluation	204,900	61,600	75,300	78,500	466,200	886,500
Total Project	*14,001,604	1,888,985	1,958,915	1,582,217	3,232,267	*22,663,988

\* Includes \$3,779,811 of Demonstration and Validation funding prior to FY 92 funded in PE 0603230F.

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Exhibit R-3 (PE 0604239F)

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PE NUMBER: 0604240F

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PE TITLE: B2 Advanced Technology Bomber

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604240F B2 Advanced Technology Bomber									
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		585,612	335,254	131,247	202,744	73,822	25,185	13,463	0	24,758,097	
3843 B-2 Advanced Technology Bomber		474,989	335,254	131,247	202,744	73,822	25,185	13,463	0	24,647,474	
4609 B-2 ENHANCEMENTS		110,623	0	0	0	0	0	0	0	110,623	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	5	

**(U) A. Mission Description and Budget Item Justification**

The B-2 SPIRIT is America's most advanced long-range strike aircraft. This all-wing two crew member aircraft has twin weapons bays of over 20,000 pounds capacity each and employs a wide array of signature reduction technologies to greatly enhance both its ability to penetrate enemy defenses and its ability to survive in a highly defended target environment. The B-2 provides global force projection capability and the ability to influence an enemy with insensitivity to the location of enemy assets or the availability of forward basing. This program is in budget activity 5 - Engineering and Manufacturing Development, because of concurrency in developing, testing, producing, and deploying the B-2.

**(U) Acquisition Strategy:**

Acquisition reform strategies are employed to achieve maximum/best value (i.e. MSIP Indefinite Delivery/Indefinite Quantity contract - limited specifications, limited contract data requirements).

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE			
5 - Engineering and Manufacturing Development		0604240F B2 Advanced Technology Bomber			
(U) B. <u>Program Change Summary (\$ in Thousands)</u>					
(U) Previous President's Budget	FY 1997	FY 1998	FY 1999	Total	
(U) Appropriated Value	595,496	355,750	44,894	Cost	24,696,293
(U) Adjustments to Appropriated Value	624,454	355,750			
a. Congressional Reductions	-13,186	-12,113			
b. SBIR	-15,772	-8,383			
c. Omnibus or Other Above Threshold Reprogram	-7,766				
d. Below Threshold Reprogramming	-1,134				
e. Rescissions	-984				
(U) Adjustments to Budget Years Since FY 1998 PB			86,353		
(U) Current Budget Submit FY1999 President's Budget	585,612	335,254	131,247		24,758,097
(U) Change Summary Explanation:					
Funding:					
FY97: Reflects \$7.8M Omnibus, \$984K rescission to support Bosnia supplemental, \$1,134K reprogrammed to support higher Air Force priorities.					
FY99: Restored \$89M for completion of rework of EMD air vehicles to fully operational capability, less \$2.6M for inflation adjustment.					
Schedule: N/A					
Technical: N/A					

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Exhibit R-2 / PE 0604240F

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

0604240F B2 Advanced Technology Bomber

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
A/C Proc, AF, Combat A/C/BA01/B-2A	85,770	323,429		189,869	111,701	31,119	16,556	7,657	30,400	17,761,640
A/C Proc, AF, Post Prod Support/BA07				15,681	21,023	13,167	15,859	9,971	16,800	387,302
A/C Proc, AF, Modifications/BA05/B-2A	9,369	13,543		0	471	470	451	455	970	220,913
A/C Proc, AF, Cmn Spt Eq/BA07/Items<\$2M	471	491		0	0	0	0	0	0	8,255
A/C Proc, AF, A/C Replen Spares/BA06/B-2A	0	0		55,509	35,445	19,417	6,915	2,409	0	0
A/C Proc, AF, A/C Initial Spares/BA06/B-2A	12,847	13,197		6,115	5,904	6,250	7,789	7,835	297	1,077,048
Proc (Other), AF/BA 02,03, 04/B-2A	9,712	10,586		0	0	0	0	0	0	91,756
Military Construction/BA01	0	27,074		0	0	0	0	0	0	74,674
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Bomber, Industrial Base Support	0	0		0	0	0	0	0	0	100,399
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/ Industrial Preparedness/PE708011F	1,000	0		0	0	0	0	0	0	9,400
Missile Proc, AF, Oth Missiles/BA42/ GPS Aided Munition/PE28030F	0	0		0	0	0	0	0	0	24,823
Related RDT&E NA										

## (U) D. Schedule Profile

	FY 1997				FY 1998				FY 1999				FY 2000				FY 2001				FY 2002				FY 2003				FY 2004			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
MSIP PMD Directions Received	*																															
JSOW/GWIS Contract Award			*																													
JSOW/GWIS Functional Final Design Review																																
JSOW/GWIS Flight Test Complete																																
JSOW/GWIS Certification																																
Flight Test Transition to Sustainment Operations																																
Block 30 First Delivery																																
Initial Operational Capability (IOC)																																
Block-30 Nuclear Certification																																

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	
5 - Engineering and Manufacturing Development	0604240F B2 Advanced Technology Bomber	February 1998
	<u>FY 1997</u>	<u>FY 1998</u>
AV-2 Block-30 Delivery (1st Mod Line Delivery)	*	
Eighth Block-30 Delivery (Completes First Squadron)		x
Full Operational Capability (FOC)		x

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
BUDGET ACTIVITY		DATE							February 1998
5 - Engineering and Manufacturing Development		PE NUMBER AND TITLE							PROJECT
		0604240F B2 Advanced Technology Bomber							3843
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Total Cost
3843 B-2 Advanced Technology Bomber		474,989	335,254	131,247	202,744	73,822	25,185	13,463	0 24,647,474

**(U) A. Mission Description and Budget Item Justification**

The B-2 SPIRIT is America's most advanced long-range strike aircraft. This all-wing two crew member aircraft has twin weapons bays of over 20,000 pounds capacity each and employs a wide array of signature reduction technologies to greatly enhance both its ability to penetrate enemy defenses and its ability to survive in a highly defended target environment. The B-2 provides global force projection capability and the ability to influence an enemy with insensitivity to the location of enemy assets or the availability of forward basing. This program is in budget activity 5 - Engineering and Manufacturing Development, Research because of concurrency in developing, testing, producing, and deploying the B-2.

**(U) FY 1997 (\$ in Thousands):**

(U) - \$108,489 Continued developmental test and evaluation  
 (U) - \$ 58,520 Continued development and support acquisition  
 (U) - \$307,980 Completed primary hardware development  
 (U) - \$474,989 Total

**(U) FY 1998 (\$ in Thousands):**

(U) - \$ 15,102 Continue developmental test and evaluation (Maintain minimal flight test infrastructure)  
 (U) - \$ 22,764 Air Force Mission Support System (AFMSS)  
 (U) - \$ 15,165 Labs and Other Government Costs  
 (U) - \$282,223 EMD Aircraft rework  
 (U) - \$335,254 Total

**(U) FY 1999 (\$ in Thousands):**

(U) - \$ 12,200 Continue developmental test and evaluation (Maintain minimal flight test infrastructure)  
 (U) - \$ 12,127 Air Force Mission Support System (AFMSS)  
 (U) - \$ 9,412 Labs and Other Government Costs  
 (U) - \$ 97,508 EMD Aircraft rework  
 (U) - \$131,247 Total



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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604240F B2 Advanced Technology Bomber	3843	

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	595,496	355,750	44,894	24,585,670
(U) Appropriated Value	508,454	355,750		
(U) Adjustments to Appropriated Value				
a. Congressional Reductions	-10,739	-12,113		
b. SBIR	-12,842	-8,383		
c. Omnibus or Other Above Threshold Reprogram	-7,766			
d. Below Threshold Reprogramming	-1,134			
e. Rescissions	-984			
(U) Adjustments to Budget Years Since FY 1998 PB			86,353	
(U) Current Budget Submit FY 1999 President's Budget	474,989	335,254	131,247	24,647,474

## (U) Change Summary Explanation:

## Funding:

FY97: Reflects \$7.8M Omnibus reprogramming, \$984K recession to support Bosnia supplemental, \$1,134K reprogrammed to support higher Air Force priorities.

FY99: Restored \$89M for completion of rework of EMD air vehicles to fully operational capability, less \$2.6M for inflation adjustment.

Schedule: N/A

Technical: N/A

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604240F B2 Advanced Technology Bomber

3843

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
A/C Proc, AF, Combat A/C/BA01/B-2A	85,770	323,429							17,761,640
A/C Proc, AF, Post Prod Support/BA07			189,869	111,701	31,119	16,556	7,657	30,400	387,302
A/C Proc, AF, Modifications/BA05/B-2A	9,369	13,543	15,681	21,023	13,167	15,859	9,971	16,800	220,913
A/C Proc, AF, Cmn Spt Eq/BA07/Items<\$2M	471	491	0	471	470	451	455	970	8,255
A/C Proc, AF, A/C Replen Spares/BA06/B-2A	0	0	0	0	0	0	0	0	0
A/C Proc, AF, A/C Initial Spares/BA06/B-2A	12,847	13,197	55,509	35,445	19,417	6,915	2,409	0	1,077,048
Proc (Other), AF/BA 02.03, 04/B-2A	9,712	10,586	6,115	5,904	6,250	7,789	7,835	297	91,756
Military Construction/BA01	0	27,074	0	0	0	0	0	0	74,674
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/	0	0	0	0	0	0	0	0	100,399
Bomber, Industrial Base Support									
A/C Proc, AF, A/C Spt Eqpt & Fac/BA07/	1,000	0	0	0	0	0	0	0	9,400
Industrial Preparedness/PE708011F									
Missile Proc, AF, Oth Missiles/BA42/	0	0	0	0	0	0	0	0	24,823
GPS Aided Munition/PE28030F									
Related RDT&E NA									

(U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
Flight Test Transition to Sustainment Operations									
Block 30 First Delivery				*					
Block 30 Nuclear Certification				*					
AV-2 Block-30 Delivery (1st Mod Line Delivery)									
Eighth Block-30 Delivery (Completes First Squadron)					x				
Full Operational Capability (FOC)							x		

Project 3843

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
5 - Engineering and Manufacturing Development		0604240F B2 Advanced Technology Bomber		3843	
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>					
		<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	
(U)	Equipment Development & Evaluation	405,481	304,987	109,635	
(U)	Government Test	37,253	15,102	12,200	
(U)	Other Government Costs (OGC)	5,019	6,165	3,332	
(U)	Other	27,236	9,000	6,080	
(U)	Total	474,989	335,254	131,247	
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>					
Performing Organizations:					
Contractor or Government	Contract Method/Type	Award or Obligation Date	Performing Activity	Project Office	Total
Performing Activity	Vehicle		EAC	EAC	
<u>Product Development Organizations</u>					
Air Vehicle - NG	CPI/AF	Nov 1981	20,916,627	21,251,418	20,265,843
Aircrew Training	CPI	Jul 1985	561,345	561,345	561,145
Mission Planning	Multiple	Multiple	326,286	326,286	253,624
					281,730
					0
					22,764
					97,358
					0
					12,127
					235,551
					0
					11,706
					21,251,418
					561,345
					326,286
<u>Support and Management Organizations</u>					
Other Govt Costs	N/A		964,832	964,832	892,956
					15165
					32,255
					9,412
					15,044
					964,832
<u>Test and Evaluation Organizations</u>					
Govt Test	N/A	N/A	849,633	849,633	732,165
					37,253
					15,102
					52,913
					849,633

Project 3843

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Exhibit R-3 (PE 0604240F)

Project 3843

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604240F B2 Advanced Technology Bomber

3843

(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)

## Government Furnished Property:

Support and Management Property:  
NoneTest and Evaluation Property:  
None

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total				
				FY 1997	FY 1997	FY 1998	FY 1999	Budget to Complete
<u>Product Development Property</u>								
Engines G.E.	Multiple		N/A	563,934	4,151	150	0	568,235
AARL Boeing	FPIF	Jun 88	N/A	121,103	4,129	343	0	125,725

Subtotal Product Development  
Subtotal Support and Management  
Subtotal Test and Evaluation

21,765,649	405,481	304,987	109,635	247,257	22,833,009
892,956	32,255	15,165	9,412	15,044	964,832
732,165	37,253	15,102	12,200	52,913	849,633
<b>Total Project</b>	<b>23,390,770</b>	<b>474,989</b>	<b>131,247</b>	<b>315,214</b>	<b>24,647,474</b>

Project 3843

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604240F B2 Advanced Technology Bomber								4609	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4609 B-2 ENHANCEMENTS		110,623	0	0	0	0	0	0	0	110,623	

(U) **A. Mission Description and Budget Item Justification**  
 B-2 enhancements will be accomplished via a Multi Staged Improvement Program (MSIP) that will plan, study, design, integrate, test, produce and support the implementation of Air Combat Command's future B-2 weapon system requirements defined in the Bomber Configuration Plan. Post Block-30 improvements pursued in this program includes projects to enhance lethality, survivability, reliability, maintainability, etc.. This program is a budget activity 5 - Engineering Manufacturing Development, because of the concurrency in developing, testing, producing, and deploying the B-2.

**ACQUISITION STRATEGY:**  
 Acquisition reform strategies are employed to achieve maximum/best value (i.e. MSIP Indefinite Delivery/Indefinite Quantity contract - limited specifications, limited contract data requirements).

(U) **FY 1997 (\$ in Thousands):**  
 - (U) \$ 10,600 Development test and evaluation.  
 - (U) \$ 25,993 Development and support acquisition.  
 - (U) \$ 74,030 Primary hardware development.  
 - (U) \$ 110,623 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998																																																							
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT																																																								
5 - Engineering and Manufacturing Development	0604240F B2 Advanced Technology Bomber	4609																																																								
<p>(U) B. <u>Program Change Summary (\$ in Thousands)</u></p> <table border="1"> <thead> <tr> <th></th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>Total Cost</th> </tr> </thead> <tbody> <tr> <td>(U) Previous President's Budget (FY9 1998 PB)</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>(U) Appropriated Value</td> <td>116,000</td> <td>0</td> <td>0</td> <td>116,000</td> </tr> <tr> <td>(U) Adjustments to Appropriated Value</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    a. Congressional Reductions</td> <td>-2,447</td> <td></td> <td></td> <td></td> </tr> <tr> <td>    b. SBIR</td> <td>-2,930</td> <td></td> <td></td> <td></td> </tr> <tr> <td>    c. Omnibus or Other Above Threshold Reprogram</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    d. Below Threshold Reprogramming</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>    e. Rescissions</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Adjustments to Budget Years Since FY 1998 PB</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(U) Current Budget Submit FY1999 President's Budget</td> <td>110,623</td> <td>0</td> <td>0</td> <td>110,623</td> </tr> </tbody> </table> <p>(U) Change Summary Explanation:</p> <p>Funding: FY 97: Congress added \$116M to accelerate post Block-30 capabilities.</p> <p>Schedule: N/A.</p> <p>Technical: N/A.</p>					FY 1997	FY 1998	FY 1999	Total Cost	(U) Previous President's Budget (FY9 1998 PB)	0	0	0	0	(U) Appropriated Value	116,000	0	0	116,000	(U) Adjustments to Appropriated Value					a. Congressional Reductions	-2,447				b. SBIR	-2,930				c. Omnibus or Other Above Threshold Reprogram					d. Below Threshold Reprogramming					e. Rescissions					(U) Adjustments to Budget Years Since FY 1998 PB					(U) Current Budget Submit FY1999 President's Budget	110,623	0	0	110,623
	FY 1997	FY 1998	FY 1999	Total Cost																																																						
(U) Previous President's Budget (FY9 1998 PB)	0	0	0	0																																																						
(U) Appropriated Value	116,000	0	0	116,000																																																						
(U) Adjustments to Appropriated Value																																																										
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(U) Adjustments to Budget Years Since FY 1998 PB																																																										
(U) Current Budget Submit FY1999 President's Budget	110,623	0	0	110,623																																																						

Project 4609

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

February 1998

## BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

## Technology Bomber

## PROJECT

**5 - Engineering and Manufacturing Development**

[illegible]

**(U) D. Schedule Profile**

	FY 1997		FY 1998		FY 1999
	1 2		1 2		1 2
MSIP PMD Direction Received	*	4	x	4	x
JSOW/GWIS Contract Award					
JSOW/GWIS Functional Final Design Review	*				
JSOW/GWIS Flt Test Complete					
JSOW/GWIS Certification					

Project 4609

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604240F B2 Advanced Technology Bomber

4609

(U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Equipment Development & Evaluation	91,530	0	0
(U) Government Test	10,600	0	0
(U) Other Government Costs	8,493	0	0
(U) Total	110,623	0	0

Project 4609

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)						DATE	February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE				PROJECT			
5 - Engineering and Manufacturing Development		0604240F B2 Advanced Technology Bomber				4609			
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)									
Performing Organizations:									
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999 Complete	Total Program
<u>Product Development Organizations</u>									
Northrop-Grumman	TBD	May 97	67,715	74,030	0	74,030	0	0	74,030
Mission Planning	TBD	Various	17,500	17,500	0	17,500	0	0	17,500
<u>Support and Management Organizations</u>									
OGC	N/A	N/A	8,493	8,493	0	8,493	0	0	8,493
<u>Test and Evaluation Organizations</u>									
Govt Test	N/A	N/A	10,600	10,600	0	10,600	0	0	10,600

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604240F B2 Advanced Technology Bomber

4609

Government Furnished Property: N/A

	<u>FY 1997</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>Budget FY 1999</u>	<u>Budget to Complete</u>	<u>Total Program</u>
Total						
Prior to						
FY 1997						
Subtotal Product Development	0	91,530	0	0	0	91,530
Subtotal Support and Management	0	8,493	0	0	0	8,493
Subtotal Test and Evaluation	0	10,600	0	0	0	10,600
Total Project	0	110,623	0	0	0	110,623

Project 4609

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PE NUMBER: 0604243F

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PE TITLE: Mnpwr Pers &amp; Trng Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604243F Mnpwr Pers & Trng Development									
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		4,132	4,112	0	0	0	0	0	0	56,104	
3818 Maintenance Skills Tutor (MST)		3,212	3,752	0	0	0	0	0	0	22,288	
4369 Air Education & Training Management System (AETMS)*		920	360	0	0	0	0	0	0	33,816*	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	0

\* Prior to FY96, funding for BPAC 4369 was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System.

**(U) A. Mission Description and Budget Item Justification**

This program develops manpower, personnel, and training (MPT) technologies to improve effectiveness of Air Force training, performance, assessment, personnel acquisition, job assignment, force management, and human performance in weapon systems. Program performs foundation studies, analyses, and risk-reduction activities to support MPT requirements for the combat air forces, other Air Force agencies, and the total force. MSTs are designed to leverage senior maintenance personnel experience, through the use of artificial intelligence, for use in training junior specialists. AETMS will be the major Air Education and Training Command (AETC) training system with emphasis on centralized training for a decentralized training environment. AETC will benefit from more standardized training command-wide. This program is in Budget Activity 5 as it provides for the development and engineering of education, training, and tutorial systems.

**(U) Acquisition Strategy:**

3818, MST - Full and open competition, inclusive of small disadvantaged firms, Cost Plus Award Fee (CPAF), Indefinite Delivery Indefinite Quantity (IDIQ) contract. Individual delivery orders will be negotiated and awarded for each tutor development, Cognitive Task Analysis (CTA), or other parts of the statement of work.

4369, AETMS - Engineering Change Proposals (ECPs) to be incorporated by modifying current Firm Fixed Price (FFP) contract with Lockheed Martin. Delivery Order on existing General Services Administration contract for analytical and engineering support and service for market survey/trade study and prototype development for the education module.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE		February 1998
5 - Engineering and Manufacturing Development	0604243F Mnpwr Pers & Trng Development		
(U) B. <u>Program Change Summary (\$ in Thousands)</u>			
	FY 1997	FY 1998	FY 1999
(U) Previous President's Budget (FY1998 PB)	4,689	4,534	4,230
(U) Appropriated Value	4,940	4,534	
(U) Adjustments to Appropriated Value			
a. Congressional/General Reductions	-144	-338	
b. SBIR	-106	-84	
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming	-550		
e. Rescissions	-8		
(U) Adjustments to Budget Years Since FY1998 PB			
(U) Current Budget Submit/1999 President's Budget	4,132	4,112	-4,230
			0
			56,104*
* Prior to FY96, funding for BPAC 4369 was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System.			
(U) Change Summary Explanation:			
Funding: FY97 and FY98 include Congressional/general reductions, SBIR, reprogrammings, and rescissions. Program terminates in FY99 due to a lack of specific user requirements.			
Schedule: Not Applicable			
Technical: Not Applicable			
(U) C. <u>Other Program Funding Summary (\$ in Thousands)</u> Not Applicable			
(U) D. <u>Schedule Profile</u>			
			See individual project R-2 Exhibits for schedule profiles

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

3818

	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3818 Maintenance Skills Tutor (MST)		3,212	3,752	0	0	0	0	0	0	22,288
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification

The MST program fields multiple computer-based tutors, intelligent tutoring systems, and training delivery systems for the Combat Air Forces, other Air Force agencies, and the Guard/Reserves to improve training of complex skills for a broad range of Air Force jobs--primarily aircraft maintenance troubleshooting. The program also conducts foundation studies, analyses, and risk-reduction activities to support training requirements. These MSTs may include some initial skills training, but primary emphasis is on the more difficult cognitive skills such as understanding and troubleshooting problems that the maintenance-aiding equipment and systems are unable to diagnose. Initial tutors will be fieldable test/research assets developed by Armstrong Lab under the Basic Job Skills (BJS) program. The System Program Office (SPO) is developing two tutors as a pre-EMD cost and schedule risk reduction effort. The Air Force will reuse the core tutor software models from this effort for the remaining tutors.

(U) FY 1997 (\$ in Thousands):

- (U) 1,036 Completed development, begin operational evaluation and fielding of the F-16 flightline Avionics A Shop Tutor  
 - (U) 2,091 Continued development of the F-16 flightline Avionics B Shop Tutor  
 - (U) 85 Continued evaluation of tutor authoring software  
 - (U) \$3,212 Total

(U) FY 1998 (\$ in Thousands):

- (U) 3,046 Complete development, operational evaluation, and fielding of the F-16 flightline Avionics A Shop tutor  
 - (U) 706 Contract administration  
 - (U) \$3,752 Total

(U) FY 1999 (\$ in Thousands):

- (U) \$0 Total

Project 3818

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## UNCLASSIFIED

## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

3818

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost continuing
(U) Previous President's Budget (FY1998 PB)	3,769	4,139	4,230	
(U) Appropriated Value	3,979	4,139		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-124	-303		
b. SBIR	-85	-84		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming	-550			
e. Rescissions	-8			
(U) Adjustments to Budget Years Since FY1998 PB			-4,230	
(U) Current Budget Submit/1999 President's Budget	3,212	3,752	0	22,288

## U) Change Summary Explanation:

Funding: FY97 and FY98 include Congressional/general reductions, SBIR, reprogrammings, and rescissions. Program terminates in FY99 due to a lack of defined user requirements.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary (\$ in Thousands): Not applicable

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

3818

(U) D. Schedule Profile

	FY 1997		FY 1998		FY 1999	
	1	2	3	4	1	2
(U) F-16 C Shop Tutor	*					
(U) F-16 C Shop OPS EVAL & Interim Contractor Support (ICS)		X				
(U) F-16 A Shop Tutor			X			
(U) F-16 A OPS EVAL & ICS					*	
(U) F-15 C Shop OPS EVAL & ICS (LAB DEV)						
(U) F-15 A Shop OPS EVAL & ICS (LAB DEV)				*		

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

3818

### (U) A. Project Cost Breakdown (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Software Development	1,495	2,182	0
(U) Interim Contractor Support (ICS) software maintenance	147	160	0
(U) Contractor Engineering Support Total	493	580	0
(U) Cognitive Task Analysis Support	736	400	0
(U) Govt Logistics Mgt Support	213	290	0
(U) Govt Audio/Visual support	0	0	0
(U) Travel	78	98	0
(U) Misc/Mission Support	50	42	0
(U) Total	3,212	3,752	0

### (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

#### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
----------------------------------------------	-----------------------------------------	--------------------------	-------------------------	--------------------	------------------------	----------------	----------------	----------------	--------------------	---------------

#### Product Development Organizations

Bolt, Beranek, & Newman (BBN)	SS/CPFF & CPAF	Feb 94	4,379	4,379	4,207	172	0	0	0	4,379
Univ. Pittsburgh	SS/CP	Feb 93	1,481	1,481	1,481	0	0	0	0	1,481
Galaxy Scientific	SS/CPFF	Jan 94	761	761	761	0	0	0	0	761
Booz Allen & Hamilton	C/CPFF	Feb 97	N/A	3,319	0	1,250	2,069	0	0	3,319

#### Support and Management Organizations

Various	N/A	N/A	N/A	N/A	6,599	1,483	783	0	0	8,865
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Project 3818

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

3818

Contractor or

Government

Performing

Activity

Contract

Method/Type

or Funding

Vehicle

Award or

Obligation

Date

Performing

Activity

EAC

Project

Office

EAC

Total

Prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

Test and Evaluation Organizations: None

Contract

Method/Type

Award or

Obligation

Date

Delivery

Date

Total

Prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

### Government Furnished Property:

Product Development Property Cognitive Task Analysis (CTA) data provided by the SPO to the software development contractors. The data describes the systems/subsystems/components and the faults/problems to be simulated. CTA data collection and analysis performed by the SPO Scientific and Engineering Technical Assistance (SETA) contractor (Operational Technologies (OPTTECH)).

C/CPFF Feb 94 Various

2,276

307

900

0

0

3,483

### Support and Management Property: Not Applicable

### Test and Evaluation Property: Not Applicable

Subtotal Product Development

Subtotal Support and Management

Subtotal Test and Evaluation

Total Project

8,725

1,729

2,969

0

0

13,423

6,599

1,483

783

0

0

8,865

0

0

0

0

0

0

15,324

3,212

3,752

0

0

22,288

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604243F Mnpwr Pers & Trng Development								4369	
			FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
4369	Air Education & Training Management System (AETMS)*		920	360	0	0	0	0	0	0	33,816*
	Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0

\* This project was generated by transfer of the Advanced Training System (ATS) project from PE 64227F, Training Systems Development, beginning in FY96.

(U) A. Mission Description and Budget Item Justification  
 AETMS expands ATS to support technical training and professional education at all AETC training activities. In this way, it provides a single command-wide education/training development, delivery, and management system. Program performs foundation studies, analyses, and risk-reduction activities to support training and professional education requirements. The program uses commercial hardware and software to yield a reliable and more maintainable system. AETMS builds upon the existing ATS and/or other commercial/newly-developed software, thus simplifying development.

(U) FY 1997 (\$ in Thousands):  
 - (U) 77 Residual tasks associated with the program management responsibility transfer of ATS to AETC  
 - (U) 843 Initiated software development studies to incorporate AETMS (professional education) functionality  
 - (U) \$920 Total

(U) FY 1998 (\$ in Thousands):  
 - (U) 360 Complete software development studies to incorporate AETMS (professional education) functionality  
 - (U) \$360 Total

(U) FY 1999 (\$ in Thousands):  
 - (U) \$0 Total

Project 4369

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Exhibit R-2 (PE 0604243F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604243F Mnpwr Pers & Trng Development	4369	
(U) B. Program Change Summary (\$ in Thousands)			
		FY 1997	FY 1998
(U) Previous President's Budget (FY1998 PB)		920	0
(U) Appropriated Value		961	395
(U) Adjustments to Appropriated Value			395
a. Congressional/General Reductions		-20	-35
b. SBIR		-21	
c. Omnibus or Other Above Threshold Reprogram			
d. Below Threshold Reprogramming			
e. Rescissions			
(U) Adjustments to Budget Years Since FY1998 PB		920	0
(U) Current Budget Submit/1999 President's Budget			33,816**
<p>* The FY98 PB showed \$2,325K as the total cost. The FY98 PB did not include prior year funding from PE 64227F, Project 3135.</p> <p>** Prior to FY96, funding for this BPAC was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System.</p>			
(U) Change Summary Explanation:			
Funding: FY97 and FY98 include Congressional/general reductions and SBIR. Program will complete in FY98.			
Schedule: Not Applicable			
Technical: Not Applicable			
(U) C. Other Program Funding Summary (\$ in Thousands): Not Applicable			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE			PROJECT
5 - Engineering and Manufacturing Development		0604243F Mnpwr Pers & Trng Development			4369
(U) D. <u>Schedule Profile</u>					
(U) Development/Studies for AETMS (Professional Education)	1	FY 1997		FY 1998	
		2	3	2	3
(U) Develop/Install prototype of AETMS Education Management System (EMS) at a professional education site	4	FY 1997		FY 1998	
		2	3	2	3
X Denotes milestone start	X	FY 1997		FY 1998	
		2	3	2	3
* Denotes milestone completion	4	FY 1997		FY 1998	
		2	3	2	3
(U) Development/Studies for AETMS (Professional Education)					
(U) Develop/Install prototype of AETMS Education Management System (EMS) at a professional education site					
X Denotes milestone start					
* Denotes milestone completion					

Project 4369

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604243F Mnpwr Pers &amp; Trng Development

4369

(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Software Development/Studies	573	165	0
(U) TEAMS	125	55	0
(U) Travel	30	29	0
(U) Training Development	0	0	0
(U) Contract Administration	192	30	0
(U) AETMS/Mission Support	0	81	0
(U) Total	920	360	0

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Lockheed Martin	C, CPAF/FPI	May 89	31,675	31,675	31,675*	0	0	0	0	31,675*
Anteon Corp	Time&Mat'l	Jun 97	287	287	0	287	0	0	0	287
TBD	TBD	TBD	671	671	0	286	246	0	0	532
<u>Support and Management Organizations</u>										
Human System Center			N/A		379	347	114	0	0	840

Test and Evaluation Organizations: Not Applicable

\* Actual funding, prior to FY96, was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System.

Project 4369

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT	
5 - Engineering and Manufacturing Development		0604243F Mnpwr Pers & Trng Development		4369	
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands)</u>					
Government Furnished Property:					
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Total Program
Product Development Property					
Dev Test III/IV	PR			482*	482*
HW & SW					
Support and Management Property: Not Applicable					
Test and Evaluation Property: Not Applicable					
Subtotal Product Development				32,157*	32,976*
Subtotal Support and Management				379	840
Subtotal Test and Evaluation				0	0
Total Project				32,536*	33,816*
* Actual funding prior to FY96 was included in PE 64227F, Flight Simulator Development, Project 3135, Advanced Training System					

Project 4369

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Exhibit R-3 (PE 0604243F)

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PE NUMBER: 0604270F

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PE TITLE: EW Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604270F EW Development									
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost		
Total Program Element (PE) Cost	93,797	75,700	90,126	75,992	53,971	54,543	45,888	Continuing	TBD		
1011 Joint Service Electronic Combat Systems Tester (JSECS)	10,304	8,918	9,801	2,994	3,047	0	0	0	46,829		
2462 Compass Call (CC)	1,682	1,213	782	762	843	2,629	2,662	Continuing	TBD		
3891 Advanced IR Countermeasures (AIRC) (Includes CMWS and ASTE)	39,725	34,852	37,335	40,545	21,472	15,595	11,564	0	300,786		
3945 RF Towed Decoy Systems	42,086	30,717	42,208	31,691	28,609	36,319	31,662	Continuing	TBD		
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0		

\* AIRCM includes four subprojects: Common Missile Warning System (CMWS), Advanced Strategic and Tactical Infrared Expendables (ASTE), Large Aircraft IRCM (LAIRC), and software upgrade to AAR-47.

\*\* Refer to individual projects for breakouts of RDT&E articles.

(U) A. **Mission Description and Budget Item Justification**

This program element (PE) consolidates engineering development efforts related to Air Force Electronic Warfare (EW) requirements. It centralizes USAF funding and management of common EW systems development. The use of these funds transition EW technologies to a installed operational capability. This PE executes projects IAW the DoD EW Master Plan to provide current capabilities to deter, detect, deceive and counter enemy acquisition and tracking of DoD operational platforms plus enemy Radio Frequency (RF) information operations worldwide. These projects include Infrared (IR) and RF situational awareness and self protection systems, command and control warfare (C2W) electronic attack systems, and test equipment to support these. The vast majority of projects contained herein are joint in nature and will lead to common systems responses to common threats. A key criterion for included projects is the need for developmental activities, therefore these programs are in Budget Activity 5 - Engineering and Manufacturing and Development.

Acquisition Strategy: See individual projects.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE			
5 - Engineering and Manufacturing Development		0604270F EW Development			
(U) B. <u>Program Change Summary (\$ in Thousands):</u>					
(U) Previous President's Budget	FY 1997	FY 1998	FY 1999	Total	
(U) Appropriated Value	97,458	78,465	87,889	Cost	
(U) Adjustments to Appropriated Value	101,923	80,465		TBD	
a. General Congressional Reduction	-2,156	-2,935			
b. SBIR	-2,309	-1,830			
c. Omnibus/other Above Threshold Reprogramming	-3,500				
d. Below Threshold Reprogramming					
e. Rescissions	-161				
(U) Adjustments to Budget Years Since FY 1998 PB			2,237		
(U) Current Budget Submit/1999 President's Budget	93,797	75,700	90,126		TBD
(U) Change Summary Explanation:					
Funding: FY99 Test Program Set (TPS) were repahsed between FY99 and FY00 due to acquisition strategy change.					
\$3,500K approved by Congress as an FY97 Omnibus Source.					
Schedule: See Project Summaries.					
Technical: See Project Summaries.					
(U) C. <u>Other Program Funding Summary (\$ in Thousands):</u> See Project Summaries.					
(U) D. <u>Schedule Profile:</u> See Project Summaries.					
....					

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604270F EW Development								1011	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
1011	Joint Service Electronic Combat Systems Tester (JSECST)	10,304	8,918	9,801	2,994	3,047	0	0	0	46,829	
Quantity of RDT&E Articles		0	5 / 1,250	0	0	0	0	0	0	0	
<b>(U) A. Mission Description and Budget Item Justification</b>											
<p>(U) The JSECST will fill both an Air Force and Navy operational requirement for a small, adaptable, and highly mobile tester capable of verifying the system level performance of installed electronic countermeasures systems. Present maintenance concepts rely on the built-in-test (BIT) capabilities of the line replaceable units (LRUs) to verify system performance. This method fails to detect failures in LRU interfaces and installed aircraft (Group A) hardware. Particular emphasis will be placed on size and weight since the test set must deploy with the operational unit.</p> <p><b>(U) Acquisition Strategy:</b> The acquisition strategy is competitive, cost-plus contracts.</p>											

Project 1011

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# RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

0604270F EW Development

PROJECT

1011

## 5 - Engineering and Manufacturing Development

### (U) A. Mission Description and Budget Item Justification: - (Continued)

#### (U) FY 1997 (\$ in Thousands)

- (U) \$7,858 Continue Core Test Set Development  
- (U) \$ 582 SPO Support  
- (U) \$ 125 Government Test  
- (U) \$1,739 Test Program Set (TPS) Lab Support  
- (U) \$10,304 Total

#### (U) FY 1998 (\$ in Thousands)

- (U) \$7,150 Continue Core Test Set Development  
- (U) \$ 740 SPO Support  
- (U) \$ 822 TPS Lab Support  
- (U) \$ 206 Government Test  
- (U) \$8,918 Total

#### (U) FY 1999 (\$ in Thousands)

- (U) \$7,781 Complete Core Test Set Development  
- (U) \$ 650 SPO Support  
- (U) \$ 750 TPS Lab Support  
- (U) \$ 620 Government Test  
- (U) \$9,801 Total

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604270F EW Development	1011	
(U) B. Program Change Summary (\$ in Thousands):			
(U) Previous President's Budget	FY 1997	FY 1998	FY 1999
(U) Appropriated Value	10,638	9,490	5,944
(U) Adjustments to Appropriated Value	11,163		
a. General Congressional Reduction	-233	-356	
b. SBIR	-292	-216	
c. Omnibus/other Above Threshold Reprogramming	-334		
d. Below Threshold Reprogramming			
e. Rescissions			
(U) Adjustments to Budget Years Since FY 1998 PB			3,857
(U) Current Budget Submit/1999 President's Budget	10,304	8,918	9,801
			*46,829
* Total includes prior year funds.			
(U) Change Summary Explanation:			
Funding: JSECST restructure resulted in an increase in FY99 and rephase of the follow-on Test Program (TSP) to FY00 and FY01. \$334K approved by Congress as an FY97 Omnibus source.			
Schedule: JSECST restructured resulting in an 6 to 12 month slip in many development activities.			
Technical: None.			
Project 1011		Exhibit R-2 (PE 0604270F)	

Project 1011

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

1011

(U) C. Other Program Funding Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF PE 27442F (Common ECM Equipment)									
(U) In Service Direct Ground Support Equipment, BP-12			7,809	18,930		34,965		0	61,704

Related Activities: None(U) D. Schedule Profile:

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
(U) Preliminary Design Review	1	2	3	4	1	2	3
(U) Critical Design Review	*						4
(U) Test Readiness Review							
(U) Developmental Test & Evaluation					X		
(U) Functional Configuration Audit						X	
(U) Initial Operational T&E (1Q-00)							X
(U) Milestone III (3Q-00)							
(U) Production Lots award (4Q-00)							

\* Denotes completed activity

X Denotes planned activity

Project 1011

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

1011

(U) A. Project Cost Breakdown (\$ in Thousands):

(U) EMD Contract	FY 1997	FY 1998	FY 1999
	7,858	7,150	7,781
(U) SPO Support	582	740	650
(U) Government Test	125	206	620
(U) TPS Lab Support	1,739	822	750
(U) Total	10,304	8,918	9,801

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands):Performing Organizations:Contract

Contractor or Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
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Product Development Organizations

AAI	CPAF	Mar 96	28,271	28,271	5,482	7,858	7,150	7,781	0	28,271
Follow on TPS Contractor	TBD	Jun 00	5,641	5,641					5,641	5,641

Support and Management Organizations

ASCLNA, NAVAIR, Wright Labs		Various			5,820	2,321	1,562	1,400	400	11,503
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Test and Evaluation Organizations

AFDTC, Eglin AFB FL					463	125	206	620	0	1,414
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT		
5 - Engineering and Manufacturing Development		0604270F EW Development		1011		
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands): (Continued)						
Government Furnished Property: None						
Item Description	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	5,482	7,858	7,150	7,781	5,641	33,912
Subtotal Support and Management	5,820	2,321	1,562	1,400	400	11,503
Subtotal Test and Evaluation	463	125	206	620	0	1,414
Total Project	11,765	10,304	8,918	9,801	6,041	46,829

Project 1011

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE

February 1998

BUDGET ACTIVITY

5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE

0604270F EW Development

PROJECT

2462

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
2462 Compass Call (CC)	1,682	1,213	782	762	843	2,629	2,662	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	TBD	TBD

**(U) A. Mission Description and Budget Item Justification:**

(U) COMPASS CALL (CC) is a fleet of EC-130H aircraft developed for command and control warfare (C2W) as stand-off platforms to disrupt enemy information operations worldwide. It is optimally employed as part of an integrated electronic attack (EA) package as it complements both present and future aerospace, ground, and sea based systems, both deployed and CONUS-based, to provide theater commanders with an integrated and comprehensive, flexible, offensive information warfare capability. This project provides a continuing technology program to keep the EC-130H current with the rapidly evolving threat.

(U) Ongoing development programs are:

(U) HBE (High Band Exciter) - Develops extended frequency coverage for High-Band Subsystem (HBS). Contractor: Raytheon (formerly Hughes), Ft Wayne, IN.

(U) TRACS (Tactical Radio Acquisition and Countermeasures Subsystem) - Develops next-generation digital receive and countermeasures subsystem. Contractor: Lockheed Martin/Sanders, Nashua NH.

**(U) Acquisition Strategy:**

The acquisition strategy is competitive, cost-plus contract.

Project 2462

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE	PROJECT
5 - Engineering and Manufacturing Development		0604270F EW Development	2462
(U) A. <u>Mission Description and Budget Item Justification:</u> - (Continued)			
(U) FY 1997 (\$ in Thousands)			
-	(U)	\$484	Continued HBE development
-	(U)	\$650	Continued TRACS development
-	(U)	\$ 49	Travel
-	(U)	\$499	New Signal Development
-	(U)	\$1,682	Total
(U) FY 1998 (\$ in Thousands)			
-	(U)	\$100	Complete HBE development
-	(U)	\$890	Continued TRACS development
-	(U)	\$223	New Signal Development
-	(U)	\$1,213	Total
(U) FY 1999 (\$ in Thousands)			
-	(U)	\$250	Complete TRACS development
-	(U)	\$532	New Signal Development
-	(U)	\$782	Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

2462

## (U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous President's Budget	1,682	1,284	798	
(U) Appropriated Value	1,718			
(U) Adjustments to Appropriated Value				
a. General Congressional Reductions	-36	-42		
b. SBIR		-29		
c. Omnibus/Other Above Threshold Reprogramming				
d. Below Threshold Reprogramming				
e. Rescissions				
(U) Adjustments to Budget Years Since FY 1998 PB			-16	
(U) Current Budget Submit/1999 President's Budget	1,682	1,213	782	TBD

## (U) Change Summary Explanation:

Funding: None.

Schedule: None.

Technical: None.

## (U) C. Other Program Funding Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF PE 27253F (Compass Call)	2,997	7,552	7,802	7,975	8,156	8,648	8,830	Cont.	N/A
(U) Mods (Compass Call; MN 1001) BA-5	585	5,867	0	0	0	0	0	Cont.	N/A
(U) Acft Replen Spares & Repairs BA-6	1	0	1,743	9,379	9,984	13,194	8,997	Cont.	N/A
(U) Acft Initial Spares & Repairs BA-6	0	0	24,647	27,747	49,882	48,644	27,075	Cont.	N/A
(U) Other Charges BA-7	3,583	13,419	34,192	45,101	68,022	70,486	44,902	Cont.	N/A
(U) TOTAL									

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
2462

5 - Engineering and Manufacturing Development

0604270F EW Development

(U) D. Schedule Profile:

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) HBE Flight Test												
(U) HBE PDR				*		X	X	X				
(U) TRACs Initial Flight Testing						X	X	X	X			
(U) TRACS PDR				*		X	X	X				X

\* Denotes completed activity

X Denotes planned activity

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

2462

## (U) A. Project Cost Breakdown (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) HBE/HBS	484	100	0
(U) TRACS	650	890	250
(U) Travel	49	0	0
(U) New Signal Development	<u>499</u>	<u>223</u>	<u>532</u>
(U) Total	1682	1,213	782

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands):

### Performing Organizations:

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total		Budget FY 1999	Budget to Complete	Total Program
					Prior to FY 1997	FY 1997			
<u>Product Development Organizations</u>									
Raytheon (IN)	SS/CPAF	2QFY98	N/A	N/A	22,739	484	100	0	23,323
GTE	SS/CPIF	2QFY98	N/A	N/A	8,875	0	200	400	9,475
LM-Sanders	SS/CPIF	2QFY98	N/A	N/A	25,556	650	847	332	27,385

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT  
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## 5 - Engineering and Manufacturing Development

0604270F EW Development

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands): (Continued)

## Performing Organizations: (Continued)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
Support and Management Organizations										
Misc (SPO, Labs)	Various	*1-4Q			2,718	454	0	0	Continuing	TBD

Test and Evaluation Organizations: Air Warfare Center conducts tests using its own funds.

\* Obligation dates are accomplished on a continuous basis.

## Government Furnished Property:

Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
Product Development Property									
Misc	Misc			1,500	94	66	50	Continuing	TBD
Support and Management Property									
None									
Test and Evaluation Property									
None									

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)					DATE	February 1998		
BUDGET ACTIVITY		PE NUMBER AND TITLE			PROJECT			
5 - Engineering and Manufacturing Development		0604270F EW Development			2462			
Item Description	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Delivery Date	Total Prior to FY 1997	Budget FY 1997	FY 1998	Budget FY 1999	Budget to Complete
Subtotal Product Development Organizations				58,767	1,228	1,213	782	0
Subtotal Support and Management				2,718	454	0	0	Continuing
Subtotal Test and Evaluation				0	0	0	0	Continuing
Total Project				61,485	1,682	1,213	782	Continuing
								60,183
								TBD
								TBD
								TBD

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604270F EW Development								3891	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3891	Advanced IR Countermeasures (AIRCMM) (includes CMWS, ASTE, LAIRCM and AAR-47)*	39,725	34,852	37,335	40,545	21,472	15,595	11,564	0	300,786	
<p>** Quantity of RDT&amp;E Articles</p>											
	CMWS Qty / \$	0 / 12,250	10 / 3,500	40 / 3,161	0	0	0	0	N/A	N/A	
	ASTE Qty / \$	3,963 / 645	3,062 / 817	0 / 0	0	0	0	0	N/A	N/A	
<p>* AIRCM includes four subprojects: Common Missile Warning System (CMWS), Advanced Strategic and Tactical Infrared Expendables (ASTE), Large Aircraft IRCM (LAIRCM), and software upgrade to AAR-47.</p> <p>** FY97 CMWS dollar values reflect developmental phase efforts. FY97/98 ASTE dollar values reflect developmental phase efforts.</p>											
<p>(U) <b>A. Mission Description and Budget Item Justification:</b></p> <p>The AIRCM project contains related aircraft self-protection efforts aimed at increasing aircraft survivability against increasing threat of sophisticated surface to air and air to air missile threats. AIRCM consists of four efforts, the tri-service Common Missile Warning System (CMWS), USAF/USN Advanced Strategic and Tactical Infrared Expendable (ASTE), USAF Large Aircraft IRCM (LAIRCM), and USAF/USN AAR-47 software upgrade. CMWS will provide timely warning of a threat missile attack with planned growth to detectable countermeasures. ASTE will provide advanced expendable countermeasures. LAIRCM will demonstrate an advanced directed laser countermeasures suite for large signature aircraft as EMD risk reduction. The software upgrade to the AAR-47 is aimed at improving its false alarm rate. The AIRCM project objective is to increase aircraft survivability against advanced SAMs, which may employ such features as next-generation electro-optics, dual infrared and radio frequency seekers, and will result in an integrated, self-protection capability tailored for current generation combat, airlift and special operations aircraft. This project was formed in FY96 by combining the FY95 USA Advanced Threat Infrared Countermeasures (ATIRCM) program with the USAF/USN Advanced Missile Warning program and the Advanced Strategic and Tactical Infrared Expendables effort. CMWS and ASTE entered EMD in Jun 95. USAF CMWS installation is planned for the F-16 and A-10 aircraft. ASTE flares will be functionally compatible with existing dispenser systems and will be employed across multiple USAF and USN weapon systems. This project, managed as a consolidated AIRCM effort, is an integral part of a Joint Service IRCM program that will maximize commonality across Air Force, Navy, and Army aircraft.</p> <p>(U) <b>Acquisition Strategy:</b></p> <p>The acquisition strategy is competitive cost-plus award fee.</p>											

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BUDGET ACTIVITY		DATE	PROJECT
RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		February 1998	3891
5 - Engineering and Manufacturing Development		PE NUMBER AND TITLE	0604270F EW Development
<p>(U) A. <u>Mission Description and Budget Item Justification:</u> (Continued)</p> <p>(U) FY1997 (\$ in Thousands)</p> <p>AIRCM (Includes CMWS, ASTE, LAIRCM, and AAR-47)</p> <p>(U) CMWS Program:</p> <ul style="list-style-type: none"> <li>- (U) \$23,531 Common Missile Warning System Joint Program Costs</li> <li>- (U) \$4,253 F-15 aircraft (Group A) EMD integration</li> <li>- (U) \$833 F-16 aircraft (Group A) EMD integration</li> <li>- (U) \$408 A-10 aircraft (Group A) EMD integration</li> <li>- (U) \$3,815 Test and Evaluation (AF only)</li> <li>- (U) \$446 Modeling and Simulation (AF only)</li> <li>- (U) \$1,844 Mission Support</li> <li>- (U) \$35,130 Total</li> </ul> <p>(U) ASTE Program:</p> <ul style="list-style-type: none"> <li>- (U) \$2,000 Joint Program Costs</li> <li>- (U) \$ 750 Test and Evaluation</li> <li>- (U) \$ 296 Verification and Validation</li> <li>- (U) \$ 369 Modeling &amp; Analysis</li> <li>- (U) \$1,180 Mission Support</li> <li>- (U) \$4,595 Total</li> </ul> <p>(U) LAIRCM</p> <p>Program:</p> <ul style="list-style-type: none"> <li>- (U) \$ 0</li> </ul> <p>(U) AAR-47</p> <p>Program:</p> <ul style="list-style-type: none"> <li>- (U) \$ 0</li> </ul> <p>- (U) \$ 39,725 AIRCM Total</p>			

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BUDGET ACTIVITY		DATE	PROJECT
<b>RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)</b>		<b>February 1998</b>	<b>3891</b>
<b>5 - Engineering and Manufacturing Development</b>		PE NUMBER AND TITLE	
		<b>0604270F EW Development</b>	
<b>(U) A. Mission Description and Budget Item Justification: (Continued)</b>			
<b>(U) CMWS Program:</b>			
<b>(U) FY 1998 (\$ in Thousands)</b>			
-	(U)	\$8,370	Common Missile Warning System Joint Program Costs
-	(U)	\$3,599	F-16 aircraft (Group A) EMD integration
-	(U)	\$2,173	A-10 aircraft (Group A) EMD integration
-	(U)	\$7,229	Test and Evaluation (AF only)
-	(U)	\$ 715	Modeling and Simulation (AF only)
-	(U)	\$2,584	Mission Support
-	(U)	\$24,670	CMWS Total
<b>(U) ASTE Program:</b>			
-	(U)	\$ 994	ASTE Joint Program Costs
-	(U)	\$5,175	C-17 Development
-	(U)	\$1,374	Test and Evaluation
-	(U)	\$ 600	Verification and Validation
-	(U)	\$ 469	Modeling & Analysis
-	(U)	\$1,570	Mission Support
-	(U)	\$10,182	ASTE Total
<b>(U) LAIRCM Program:</b>			
-	(U)	\$ 0	
<b>(U) AAR-47 Program:</b>			
-	(U)	\$ 0	
-	(U)	\$34,852	AIRCM Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

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(U) A. Mission Description and Budget Item Justification: (Continued)

(U) FY1999 (\$ in Thousands)

(U) CMWS Program:

- (U) \$6,918 Common Missile Warning System Joint Program Costs  
 - (U) \$9,251 F-16 aircraft (Group A) EMD integration  
 - (U) \$5,000 A-10 aircraft (Group A) EMD integration  
 - (U) \$7,714 Test and Evaluation (AF only)  
 - (U) \$1,320 Modeling and Simulation (AF only)  
 - (U) \$4,499 Mission Support  
 - (U) \$34,702 CMWS Total

ASTE Program:

- (U) \$ 0 ASTE Joint Program Cost  
 - (U) \$ 400 C-17 Development  
 - (U) \$ 428 Test and Evaluation  
 - (U) \$ 100 Modeling and Analysis  
 - (U) \$ 248 Mission Support  
 - (U) \$1,176 ASTE Total

LAIRCM Prog:

- (U) \$ 100 Installation Analysis  
 - (U) \$ 450 Technology Transition & Affordability Analysis  
 - (U) \$ 150 Modeling and Simulation  
 - (U) \$ 77 Mission Support  
 - (U) \$ 777 LAIRCM Total

AAR-47 Prog:

- (U) \$ 200 Data Collection  
 - (U) \$ 480 Modeling and Analysis  
 - (U) \$ 680 AAR-47 Total  
 - (U) \$37,335 LAIRCM Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

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(U) B. Program Change Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous President's Budget	40,913	31,983	38,088	
(U) Appropriated Value	42,802	36,983		
(U) Adjustments to Appropriated Value				
a. General Congressional Reduction	-919	-1,289		
b. SBIR	-970	-842		
c. Omnibus/other Above Threshold Reprogramming	-1,110			
d. Below Threshold Reprogramming				
e. Rescissions	-78			
(U) Adjustment to budget year Since FY 1998 PB			-753	
(U) Current Budget Submit/1999 President's Budget	39,725	34,852	37,335	TBD

(U) B. Program Change Summary (\$ in Thousands): (Continued)

## (U) Change Summary Explanation:

## Funding:

\$1,110K from AIRCM was a FY97 Omnibus source. Funding for LAIRCM and AAR-47 separated from CMWS and ASTE programs in FY99

## Schedule:

CMWS: Platform Integration, DT&E, IOT&E and MSIII have slipped outward due to delays in hardware availability and shortfalls in FY98 Army funding. LAIRCM and AAR-47 start in FY99.

ASTE: The Covert test dates moved to the right one quarter because the program was re-baselined to change the form factor of the Navy's expendables (the Navy and AF expendables are now common). This combined the Covert and Fighter test programs and a combined MSIII review has moved one quarter to the right. ASTE is still within the Acquisition Program baseline (APB) schedule.

LAIRCM: Begin large aircraft testbed integration for airborne demonstration of two color IR missile warning, mini jamhead and multi-band laser, closed loop IR countermeasures system.

AAR-47 Software Upgrade: Begin software development to improve AAR-47 false alarm rates.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604270F EW Development

PROJECT

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Technical:

ASTE: ASTE program changes reflect recent USN decision to pursue square flare form factor design (current USAF configuration) making the new flare common across the two services.

LAIRCM: Begin large aircraft testbed integration for airborne demonstration of two color IR missile warning, mini jamhead and multi-band laser, closed loop IR countermeasures system.

AAR-47 Software Upgrade: Collect/Analyze data.

## (U) C. Other Program Funding Summary (\$ in Thousands):

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost
(U) Aircraft Procurement, AF, PE 27442F									
Mods, F-16/A-10 CMWS, BA-5		11		27,060	49,411	72,886	100,044	590,393	839,805
(U) Procurement of Ammunition, AF, PE 28030F									
ASTE flares, BA-1, Appn 3011			5,000	4,968	4,975	4,982	4,989	Cont.	Cont.
(U) RDT&E, AF, PE 63270F									
EO/IR Warning & Countermeasures, BA-3	13,050	13,809	9,167	10,889	13,303	11,119	11,119	Cont.	Cont.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

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(U) D. Schedule Profile:

(U) Project 3891, AIRCM

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) ASTE PDR - Fighter	*											
(U) ASTE PDR - Covert												
(U) ASTE CDR - Fighter			*									
(U) ASTE CDR - Covert				*								
(U) ASTE DT&E - Fighter/Covert					*	X						
(U) ASTE OT&E - Fighter/Covert												
(U) ASTE MS III - Fighter/Covert								X				
(U) ASTE CDR - Transport									X			
(U) ASTE DT&E-Transport										X		
(U) ASTE OT& - Transport (Mar00)									X			
(U) ASTE PDR - B-1B												
(U) CMWS CDR	*											
(U) CMWS Contractor Qual Test							X					
(U) CMWS Platform Integration								X				
(U) CMWS DT&E									X			
(U) CMWS IOT&E										X		
(U) CMWS MSIII (Mar 01)												
(U) LAIRCM Testbed Design CDR											X	
(U) AAR-47 SW Upgrade Contract										X		

\* Denotes completed activity

X Denotes planned activity

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604270F EW Development

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(U) A. Project Cost Breakdown (\$ in Thousands):

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) CMWS Program			
(U) CMWS Group B	23,531	8,370	6,918
(U) F-15 Aircraft (group A) EMD integration	4,253		
(U) F-16 Aircraft (group A) EMD integration	833	3,599	9,251
(U) A-10 Aircraft (group A) EMD integration	408	2,173	5,000
(U) CMWS Test	3,815	7,229	7,714
(U) CMWS Modeling and Simulation	446	715	1,320
(U) CMWS Mission Support	1,844	2,584	4,499
Sub-Total (CMWS)	35,130	24,670	34,702
(U) ASTE Program			
(U) ASTE Joint Program Costs	2,000	994	0
(U) ASTE C-17 Development	0	5,175	400
(U) ASTE Test & Evaluation	750	1,374	428
(U) ASTE Verification & Validation	296	600	0
(U) ASTE Modeling and Analysis	369	469	100
(U) ASTE Mission Support	1,180	1,570	248
Sub-Total (ASTE)	4,595	10,182	1,176

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE		
5 - Engineering and Manufacturing Development		0604270F EW Development		
(U) A. Project Cost Breakdown (\$ in Thousands)(Continued):		PROJECT 3891		
		FY 1997	FY 1998	FY 1999
(U) LAIRCM Program				
(U) LAIRCM Installation Analysis				100
(U) LAIRCM Tech Transition/Affordability Planning				450
(U) LAIRCM Modeling and Simulation				150
(U) LAIRCM Development Mission Support				77
Sub-Total (LAIRCM)				777
(U) AAR-47 Program				
(U) AAR-47 Data Collection				200
(U) AAR-47 Modeling & Analysis				480
Sub-Total (AAR-47)				680
Total (CMWS, ASTE, LAIRCM, and AAR-47)		39,725	34,852	37,335

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

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BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

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(U) B. Budget Acquisition History and Planning Information (\$ in Thousands):Performing Organizations:

Contractor or  
Government  
Performing  
Activity

Method/Type  
or Funding  
Vehicle

Award or  
Obligation  
Date

Performing  
Activity  
EAC

Project  
Office  
EAC

Total  
Prior to  
FY 1997

Budget  
FY 1997

Budget  
FY 1998

Budget  
FY 1999

Budget to  
Complete

Total  
Program

Product Development OrganizationsPrime Contractors:

ASTE - Tracor	CPAF	Nov 95	14,893	14,893	6,314	2,010	6,169	400	0	14,893
CMWS - Sanders	CPAF	Sep 95	48,717	48,717	17,990	18,418	4,760	3,893	3,656	48,717
CMWS Update	TBD	TBD	25,379	25,379	0	0	0	0	25,379	25,379
CMWS Integration (Airframe Contractors)	CPAF	Various	73,513	73,513	16,762	5,494	5,772	14,251	31,234	73,513

LAIRCM - LMTDS

CPFF	Aug 94	4,609	4,609	0	0	0	0	690	3,919	4,609
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AAR-47 - GTRI

TBD	2Q99	TBD	1445	0	0	0	0	680	765	1445
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Total Product  
Development

		TBD	TBD	41,066	25,922	16,701	19,914	64,953	168,556
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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)									
DATE February 1998									
PROJECT 3891									
BUDGET ACTIVITY									
PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development									
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands): (Continued)									
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete Total Program
<u>Support and Management Organizations</u>									
ASTE M&A -SAIC	PR		2,118	2,118	780	369	469	100	400
ASTE V&V Mac B	PR		1,156	1,156		226	600	0	330
ASTE-Misc	Various		37,766	37,766	34,220	1,240	1,570	248	748
									37,997
CMWS - CAS, Inc	CPFF	Sep 95	30,560	30,560	9,717	5,113	3,610	3,025	9,095
CMWS - AOA	FP	Jun 97	4,205	4,205		927	1,061	1,092	1,125
CMWS - Mod & Sim	CPFF	Sep 95	5,216	5,216	1,850	446	715	1,320	885
CMWS - Misc Partnership Process	Various	Various	19,044	19,044	5,080	917	1,523	3,407	8,321
					2,000				2,000
LAIRCM	TBD	TBD	TBD	157	0	0	0	77	80
									157
Total Support & Mgmt			TBD	100,222	53,647	9,238	9,548	9,269	20,984
									102,686

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY					PE NUMBER AND TITLE					PROJECT	
5 - Engineering and Manufacturing Development					0604270F EW Development					3891	
Performing Organizations: (Continued)											
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Test and Evaluation Organizations											
CMWS											
(46TW or Navy test organization)	Various	2QFY97	25,805	25,805	4,984	3,815	7,229	7,714	2,350	26,092	
ASTE - 46TW or OTEVFOR or PAX-RIVER	Various	2QFY97	3,629	3,629	0	750	1,374	428	850	3,402	
LAIRCM - 46TW	Various	TBD	50	50	0	0	0	10	40	50	
Total Test and Eval			29,484	29,484	4,984	4,565	8,603	8,152	3,240	29,544	

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604270F EW Development

PROJECT

3891

Government Furnished Property: Not Applicable

	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	41,066	25,922	16,701	19,914	64,953	168,556
Subtotal Support and Management	53,647	9,238	9,548	9,269	20,984	102,686
Subtotal Test and Evaluation	4,984	4,565	8,603	8,152	3,240	29,544
Total Project	99,697	39,725	34,852	37,335	89,177	300,786

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604270F EW Development								3945	
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
3945	RF Towed Decoy Systems	42,086	30,717	42,208	31,691	28,609	36,319	31,662	Continuing	TBD	
<p><b>*Note:</b> RDT&amp;E funds are used for integration, lab, and test assets. Hardware is purchased by component, not as a complete upgrade kit, therefore aircraft quantity/\$ does not accurately portray the IDECM Program.</p> <p>(U) A. <u>Mission Description and Budget Item Justification</u>            (U) This project develops, integrates and tests radio frequency (RF) towed decoy systems on several aircraft. RF towed decoys are low cost, end game countermeasures that provide increased survivability against monopulse, semi-active, and active RF missile threats. The program is developing two classes of decoy systems, the ALE-50 and the Integrated Defensive Electronic Countermeasures (IDECM). Both of these efforts are joint programs with the Navy as lead service. Air Force funding pays for unique Air Force development requirements and integration and test on Air Force platforms.</p> <p>(U) ALE-50: The Air Force ALE-50 program is developing, integrating, and testing a modified version of the Navy's ALE-50 decoy system for the F-16 and B-1B. The components of the F-16 system include: the F-16 pylon assembly (modified 16S350 pylon), launcher/controller, magazines, canister, towline assembly, and the ALE-50 decoy called the Advanced Airborne Expendable Decoy (AAED). The major components of the B-1B system include: the multi-platform launch controller (MPLC), launcher, magazine, canister, towline assembly and the AAED.</p> <p>(U) IDECM: The Navy's goal in IDECM is to develop an integrated ECM suite for the F/A-18E/F. The Air Force is participating in IDECM to jointly develop a common IDECM techniques generator (TG) and a high power Fiber Optic Towed Decoy (FOTD). Air Force funding pays for unique Air Force development costs under IDECM as well as integration and test on the F-15. The Defensive Suppression Upgrade Program (DSUP) program will fund integration and test of IDECM hardware on the B-1B.</p> <p>(U) <u>Acquisition Strategy:</u>            The acquisition strategy for ALE-50 is sole source, cost-plus.            The acquisition strategy for IDECM is competitive, cost-plus.</p>											
Quantity of RDT&E Articles											
B-1 Qty/\$ (IDECM Only)		N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	
F-15 Qty/\$ (IDECM Only)		N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604270F EW Development

PROJECT

3945

(U) A. Mission Description and Budget Item Justification - (Continued)

## (U) FY 1997 (\$ in Thousands):

- (U) \$9,687 ALE-50 Common  
 - (U) \$7,473 ALE-50 B-1  
 - (U) \$8,941 IDECM Common  
 - (U) \$2,488 IDECM F-15  
 - (U) \$10,395 Test Support  
 - (U) \$3,102 Mission Support  
 - (U) \$42,086 Total

## (U) FY 1998 (\$ in Thousands):

- (U) \$177 ALE-50 Common  
 - (U) \$3,134 ALE-50 B-1  
 - (U) \$13,365 IDECM Common  
 - (U) \$11,600 IDECM F-15  
 - (U) \$1,048 IDECM Mission Support  
 - (U) \$250 ALE-50 Test Support  
 - (U) \$1,143 ALE-50 Mission Support  
 - (U) \$30,717 Total

## (U) FY 1999 (\$ in Thousands):

- (U) \$12,505 IDECM Common  
 - (U) \$28,600 IDECM F-15  
 - (U) \$1,103 Mission Support  
 - (U) \$42,208 Total

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

3945

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost TBD
(U) Previous President's Budget	44,225	35,708	43,059	
(U) Appropriated Value	46,240	32,708		
(U) Adjustments to Appropriated Value				
a. General Congressional Reductions	-968	-1,248		
b. SBIR	-1,047	-743		
c. Omnibus or Other Above Threshold Reprogram	-2,056			
d. Below Threshold Programming				
e. Rescissions	-83			
(U) Adjustments to Budget Years Since FY 1998 PB			-851	
(U) Current Budget Submit / 99 President's Budget	42,086	30,717	42,208	TBD

## (U) Change Summary Explanation:

Funding: None.

Schedule: B-1 AAED 1st Flight Readiness Review slid to Jan 97 due to more time required for OT&E Report. B-1 DSUP MS II slid from 2Q CY97 to 3Q CY97 due to JROC schedule change. F-15/IDECM Integration contract delay due to ORD development delays.

Technical: None.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604270F EW Development

3945

(U) D. Schedule Profile

	FY 1997				FY 1998				FY 1999			
	1	2	3	4	1	2	3	4	1	2	3	4
(U) F-16 ALE-50 Milestone III	*											
(U) B-1B 1st Flight Readiness Review												
(U) B-1 DSUP Milestone II	*											
(U) B-1B ALE-50 Milestone III						X						
(U) F-15/IDECM Integration Decision MSII				*								
(U) F-15/IDECM Integration Contract Award									X			
(U) IDECM DT/OT&E							X					
(U) IDECM DT2B							X					
(U) First USAF Subsystem Delivery (IDECM)								X				
(U) IDECM Functional Quality Test									X			
(U) F-15/IDECM CDR										X		
(U) F-15/IDECM TRR												X
(U) F-15/IDECM DT/OT&E							X					

\* Denotes completed activity

X Denotes planned activity

Note: See Change Summary

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY		PROJECT	
5 - Engineering and Manufacturing Development		3945	
PE NUMBER AND TITLE			
0604270F EW Development			
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>			
	FY 1997	FY 1998	FY 1999
(U) ALE-50 Common	9,687	177	0
(U) ALE-50 B-1	7,473	3,134	0
(U) IDECM Common	8,941	13,365	12,505
(U) IDECM F-15	2,488	11,600	28,600
(U) Mission and Test Support	13,497	2,441	1,103
(U) Total	42,086	30,717	42,208

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604270F EW Development								3945	
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)											
Performing Organizations:											
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Product Development Organizations											
Prime Contractors											
B-1 ALE-50 - Rockwell/ (Boeing North American)	CPAF	Apr 95	23,088	23,088	*	7,473	3,134	0.00	0.00	TBD	
ESGD- Raytheon											
USAF AN/ALE-50 EMD Support Contract - ESGD Raytheon	CPIF/ FFP/ T&M	Jan 96	9,016	9,016	*	8,684	177	0.00	0.00	TBD	
USAF IDECM Development - Sanders Development - ESGD	CPAF /CPIF	Nov 95	34,000 7,000	34,000 7,000	*	8,383 116	7,442 5,162	9,611 1,644		TBD	
F-15 IDECM Integration - McAir/Northrop/Lockheed-Martin	CPFF	Aug 97	102,800	102,800	*	2,448	11,600	28,600		TBD	
ALQ-184(v)9 ESGD-Raytheon	Misc	Jan 96	7,791	8,096	*	1,003	0.00	0.00	TBD	TBD	
Misc Development Contracts	CPFF				*	442	761	1,250		TBD	
Total Prime					*	28,589	28,276	41,105	TBD	TBD	
* Funding for this effort transferred from multiple formerly classified projects in FY97.											
Project 3945										Exhibit R-3 (PE 0604270F)	

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604270F EW Development								3945	
(U) B. Budget Acquisition History and Planning Information (\$ in Thousands): (Continued)											
Performing Organizations: (Continued)											
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity	Project Office	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Support and Management Organizations and Economic Change Orders											
ASC/SM/YF											
ALE-50		Misc	Sep 98	N/A	*	1,551	1,143	0.00	TBD	TBD	
IDECM				N/A	*	1,551	1,048	1,103	TBD	TBD	
Total Support & Management					*	3,102	2,191	1,103	TBD	TBD	
Test and Evaluation Organizations											
AFOTEC		Sep 98	N/A		*	2,280	250	0.00	TBD	TBD	
AFFTC			N/A		*	7,805	0.00	0.00	TBD	TBD	
Edwards			N/A		*	10	0.00	0.00	TBD	TBD	
ALQ 184v(9) Flight Test			N/A		*	300	0.00	0.00	TBD	TBD	
Total Test & Evaluation					*	10,395	250	0.00	TBD	TBD	
* Funding for this effort transferred from multiple formerly classified projects in FY97.											
Government Furnished Property: None.											

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				DATE	February 1998	
BUDGET ACTIVITY		PE NUMBER AND TITLE		PROJECT		
5 - Engineering and Manufacturing Development		0604270F EW Development		3945		
(U) B. <u>Budget Acquisition History and Planning Information Continued (\$ in Thousands):</u> (Continued)						
Item Description	Total Prior to FY 1997	FY 1997	FY 1998	Budget FY 1999	Budget to Complete	Total Program
Subtotal Product Development	*	28,589	28,276	41,105	TBD	TBD
Subtotal Support and Management	*	3,102	2,191	1,103	TBD	TBD
Subtotal Test and Evaluation	*	10,395	250	0	TBD	TBD
Total Project	*	42,086	30,717	42,208	TBD	TBD
* Funding for this effort transferred from multiple formerly classified projects in FY97.						

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PE NUMBER: 0604441F

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PE TITLE: Space Based IR Arch (EMD) (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE									
5 - Engineering and Manufacturing Development		0604441F Space Based IR Arch (EMD) (Space)									
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
Total Program Element (PE) Cost		193,018	316,467	538,438	564,239	395,905	269,798	143,059	350,725	2,801,661	
3616 SBIRS High Element EMD		189,318	316,467	538,438	564,239	395,905	269,798	143,059	350,725	2,760,563	
0002 Miniature Sensor Technology Integration (MSTI)		3,700	0	0	0	0	0	0	0	41,098	
Quantity of RDT&E Articles		0	0	0	0	1*	1*	2*	0	4	

Notes: Unit cost not available.

SBIRS Low EMD funding previously included in this PE was transferred to PE #604442F to establish a SBIRS Low EMD Program Element.

\*One each HEO sensor delivered in FY01 and FY03, one each GEO spacecraft delivered in FY02 and FY03

**(U) A. Mission Description and Budget Item Justification**

(U) The Space-Based Infrared System's (SBIRS) primary mission is to provide initial warning of a ballistic missile attack on the US, its deployed forces or its allies. SBIRS will incorporate new technologies to enhance detection; improve reporting of ICBM, SLBM and tactical ballistic missiles; and provide critical mid-course tracking and discrimination data for national and theater missile defense. This will provide increased performance in order to meet requirements in US Space Command's Capstone Requirement Document and Operations Requirements Document. SBIRS will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated centralized ground station serving all SBIRS space elements and Defense Support System (DSP) satellites. Funding was provided in FY97 for the Miniature Sensor Technology Integration (MSTI) program which completed in FY97. This Program Element funds SBIRS Engineering and Manufacturing Development (EMD) activities and is assigned to Budget Activity 5, Engineering and Manufacturing Development.

**(U) Acquisition Strategy:**

(U) SBIRS is a lead program for acquisition streamlining. Program documentation has been consolidated into a single document, the Single Acquisition and Management Plan (SAMP). The pre-EMD contracts were competed in full and open competition. Two contracts were awarded to Lockheed/Loral/Aerojet and Hughes/TRW for the pre-EMD phase. A single contract was awarded to Lockheed Martin for the EMD phase.

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

## 5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget(FY1998 PB)	189,638	338,413	580,298	2,980,497
(U) Appropriated Value	199,190	338,413		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-4,689	-13,580		
b. SBIR	-4,863	-8,366		
c. Omnibus or Other Above Threshold Reprogram	3,700			
d. Below Threshold Reprogramming	-320			
e. Rescissions				
(U) Adjustments to Budget Years Since FY1998 PB			-41,860	
(U) Current Budget Submit/FY 1999 President's Budget	193,018	316,467	538,438	2,801,661

## (U) Change Summary Explanation:

Funding: FY97 BTR of \$3,700K for MSTL. \$320K supports congressional rescissions for the Bosnia supplemental.

\$2,279K FY98 RDT&E is pending reprogramming to fund higher priority AF requirements.

\$10.86M FY99 reduction for Non Pay inflation, \$31.0M realigned to PE 64442F to establish a SBIRS Low EMD program element.

In order to maintain the program baseline, \$21.6M FY98 Above Threshold Reprogramming and \$25.9M Special Termination Cost Clause waiver will be submitted to Congress in early March 1998. Additional shortfalls are being fixed through internal program restructuring.

Schedule: Not Applicable

Technical: Not Applicable

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) Missile Procurement (PE 0305915F, BA-45, P-1-N/A)	0	0	0	0	33,510	214,402	188,455	5,478,000	5,914,367

## Related RDT&amp;E:

(U) PE 603441F - SBIRS Dem/Val	252,492	202,433	160,262	154,133	115,398	0	0	0	1,432,558
(U) PE 305911F - DSP	24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
(U) PE 604442F - SBIRS Low EMD	0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					
BUDGET ACTIVITY	DATE February 1998				
<b>5 - Engineering and Manufacturing Development</b>	<b>PE NUMBER AND TITLE 0604441F Space Based IR Arch (EMD) (Space)</b>				
(U) D. <u>Schedule Profile</u>	FY 1997	FY 1998	FY 1999		
	1 2 3 4	1 2 3 4	1 2 3 4		
(U) EMD Authority To Proceed (ATP)	X				
(U) Preliminary Requirements Review (PPR)	X				
(U) GRND INC-1 Interim Design Review	X				
(U) HOSV/Spaceraft Prelim Design Revw					
(U) GRND INC-2 Interim Design Review		X			
(U) System Preliminary Design Review					
(U) Payload Critical Design Review					
(U) HOSV/Speccrft Crtical Design Rvw					
(U) System Critical Design Review					
(U) Consolidated Grnd IOC for DSP					
(U) Grnd IOC for HIGH (FY01)					
(U) First HEOD Delivery (FY01)					
(U) First GEO Launch (FY02)					

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998																																																																																																																																														
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT																																																																																																																																															
5 - Engineering and Manufacturing Development		0604441F Space Based IR Arch (EMD) (Space)								3616																																																																																																																																															
COST (\$ In Thousands)		FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost																																																																																																																																															
3616	SBIRS High Element EMD	189,318	316,467	538,438	564,239	395,905	269,798	143,059	350,725	2,760,563																																																																																																																																															
<p>(U) <u>A. Mission Description and Budget Item Justification</u></p> <p>(U) The Space-Based Infrared System's (SBIRS) primary mission is to provide initial warning of a ballistic missile attack on the US, its deployed forces or its allies. SBIRS will incorporate new technologies that would enhance detection; improve reporting of ICBM, SLBM and tactical ballistic missiles; and provide critical mid-course tracking and discrimination data for national and theater missile defense. The system will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated, centralized ground station serving all space elements of the SBIRS system and the Defense Support Program (DSP) satellites. This Program Element funds SBIRS High Engineering and Manufacturing Development (EMD) activities and is assigned to Budget Activity 7, Engineering and Manufacturing Development.</p> <p>(U) <u>Acquisition Strategy:</u></p> <p>(U) SBIRS is a lead program for acquisition streamlining. The pre-EMD contracts were competed in full and open competition. Two contracts were awarded to Lockheed/Loral/Aerojet and Hughes/TRW for the pre-EMD phase. A single contract was awarded to Lockheed Martin for the EMD phase.</p> <p>(U) <u>FY 1997</u></p> <table> <tr> <td>-</td> <td>(U)</td> <td>\$171,918</td> <td colspan="8">Initiated EMD contracts for Space and Ground segment development</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 7,200</td> <td colspan="8">Continued System Program Office Support</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 10,200</td> <td colspan="8">Technical analysis and independent verification and validation of contractor by FFRDC</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$189,318</td> <td colspan="8">Total</td> </tr> </table> <p>(U) <u>FY 1998</u></p> <table> <tr> <td>-</td> <td>(U)</td> <td>\$294,988</td> <td colspan="8">Continue EMD contracts for Space and Ground segment development</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 9,000</td> <td colspan="8">Continue System Program Office Support</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 2,279</td> <td colspan="8">Reserved for Anticipated Cut for Inflation Adjustment and Small Business Innovative Research</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 10,200</td> <td colspan="8">Technical analysis and independent verification and validation of contractor by FFRDC</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$316,467</td> <td colspan="8">Total</td> </tr> </table> <p>(U) <u>FY 1999</u></p> <table> <tr> <td>-</td> <td>(U)</td> <td>\$518,838</td> <td colspan="8">Continue EMD contracts for Space and Ground segment development</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 9,400</td> <td colspan="8">Continue System Program Office Support</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$ 10,200</td> <td colspan="8">Technical analysis and independent verification and validation of contractor by FFRDC</td> </tr> <tr> <td>-</td> <td>(U)</td> <td>\$538,438</td> <td colspan="8">Total</td> </tr> </table>											-	(U)	\$171,918	Initiated EMD contracts for Space and Ground segment development								-	(U)	\$ 7,200	Continued System Program Office Support								-	(U)	\$ 10,200	Technical analysis and independent verification and validation of contractor by FFRDC								-	(U)	\$189,318	Total								-	(U)	\$294,988	Continue EMD contracts for Space and Ground segment development								-	(U)	\$ 9,000	Continue System Program Office Support								-	(U)	\$ 2,279	Reserved for Anticipated Cut for Inflation Adjustment and Small Business Innovative Research								-	(U)	\$ 10,200	Technical analysis and independent verification and validation of contractor by FFRDC								-	(U)	\$316,467	Total								-	(U)	\$518,838	Continue EMD contracts for Space and Ground segment development								-	(U)	\$ 9,400	Continue System Program Office Support								-	(U)	\$ 10,200	Technical analysis and independent verification and validation of contractor by FFRDC								-	(U)	\$538,438	Total							
-	(U)	\$171,918	Initiated EMD contracts for Space and Ground segment development																																																																																																																																																						
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Project 3616

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Exhibit R-2 (PE 0604441F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

3616

(U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget(FY 1998 PB)	189,638	338,413	580,298	2,939,399
(U) Appropriated Value	189,638	338,413		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions		-13,580		
b. SBIR		-8,366		
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogramming				
e. Rescissions	-320			
(U) Adjustments to Budget Years Since FY 1998 PB			-41,860	
(U) Current Budget Submit/ FY 1999 President's Budget	189,318	316,467	538,438	2,760,563

## (U) Change Summary Explanation:

Funding: FY97 BTR of \$3,700K for MSTI. \$320K supports congressional rescissions for the Bosnia supplemental.

\$2,279K FY98 RDT&E is pending reprogramming to fund higher priority AF requirements.

\$10.86M FY99 reduction for Non Pay inflation, \$31.0M realigned to PE 64442F to establish a SBIRS Low EMD program element.

In order to maintain the program baseline, \$21.6M FY98 Above Threshold Reprogramming and \$25.9M Special Termination Cost Clause waiver will be submitted to Congress in early March 1998. Additional shortfalls are being fixed through internal program restructuring.

Schedule: Not Applicable

Technical: Not Applicable

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) Missile Procurement (PE 0305915F, BA-45, P-1-N/A)	0	0	0	0	33,510	214,402	188,455	5,478,000	5,914,367
<u>Related RDT&amp;E:</u>									
(U) PE 603441F - SBIRS Dem/Val	252,492	202,433	160,262	154,133	115,398	0	0	0	1,432,558
(U) PE 305911F - DSP	24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
(U) PE 604442F - SBIRS Low EMD	0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056

Project 3616

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

3616

(U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) EMD Authority To Proceed (ATP)	X								
(U) Preliminary Requirements Review (PPR)		X							
(U) GRND INC-1 Interim Design Review		X							
(U) GRND INC-1 Final Design Review				X					
(U) Payload Preliminary Design Review				X					
(U) HOSV/Spacecraft Preliminary Design Rev					X				
(U) GRND INC-2 Preliminary Design Review					X				
(U) System Preliminary Design Review									
(U) Payload Critical Design Review									
(U) HOSV/Spacecraft Critical Design Review						X			
(U) GRND INC-2 Critical Design Review						X			
(U) System Critical Design Review									
(U) Consolidated Grnd IOC for DSP							X		
(U) Grnd IOC for HIGH (FY01)								X	
(U) First HEO Delivery (FY01)									
(U) First GEO Launch (FY02)									

Project 3616

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

3616

(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) EMD Contract	171,918	295,767	519,617
(U) System Program Office Support	7,200	9,000	9,400
(U) Aerospace Corp	10,200	9,421	9,421
(U) Adjustment: (Pending Reprogramming for Inf. Adj/SBIR)		2,279	
(U) Total	189,318	316,467	538,438

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or Contract

Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
LMMS & TRW	C/CPFF	Jul 95	164,943	164,943	164,943	0	0	0	0	164,943
<u>(Pre-EMD)</u>										
LMMS (EMD)	C/CPAF	Nov 96				171,918	295,767	519,617	1,322,767	2,310,069
TBD(Technology)	Various	Sep 95	11,600	11,600	11,600	0	0	0	0	11,600
TBD(Phenom)	Various	Sep 95	17,350	17,350	17,350	0	0	0	0	17,350
Sandia Nat'l Lab	Various	Sep 95	10,000	10,000	10,000	0	0	0	0	10,000
<u>(Cobra Brass)</u>										

Support and Management Organizations

Aerospace Corp	MORD	Sep 95	N/A	N/A	19,200	10,200	9,421	9,421	71,400	119,642
Prgm Mgmt Supt	Various	Sep 95	N/A	N/A	12,900	7,200	9,000	9,400	81,400	119,900

Test and Evaluation Organizations

Not Applicable

Project 3616

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	February 1998
BUDGET ACTIVITY			PE NUMBER AND TITLE							PROJECT	
5 - Engineering and Manufacturing Development			0604441F Space Based IR Arch (EMD) (Space)							3616	
(U) B. Budget Acquisition History and Planning Information Continued (\$ in Thousands)											
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program	
Government Furnished Property: Not Applicable.											
Subtotal Product Development											
Subtotal Support and Management											
Subtotal Test and Evaluation											
Adjustment (FY 98 pending reprogramming for inflation adjustments/SBIR)											
Adjustment (SBIRS Pre-EMD Contract Adjustments)											
Total Project											

Project 3616

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Exhibit R-3 (PE 0604441F)

Project 3616

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

0002

COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0002 Miniature Sensor Technology Integration (MSTI)	3,700	0	0	0	0	0	0	0	41,098

(U) A. Mission Description and Budget Item Justification

(U) The Miniature Sensor Technology Integration (MSTI) program provides phenomenology data for the SBIRS program.

(U) FY 1997

- (U) \$3,700 Continued on-orbit operations &amp; program support.

- (U) \$3,700 Total

(U) FY 1998

- (U) 0 Total

(U) FY 1999

- (U) 0 Total

(U) B. Program Change Summary (\$ in Thousands)

(U) Previous President's Budget(FY 1998 PB)

(U) Appropriated Value

(U) Adjustments to Appropriated Value

a. Cong Gen Reductions

b. SBIR

c. Internal Realignment Reprogramming

d. Below Threshold Reprogramming

(U) Adjustments to Budget Years Since FY 1998 PB

(U) Current Budget Submit/ FY 1999 President's Budget

(U) Change Summary Explanation:

Funding: BTR of \$3,700K in FY97 for MSTI continued on-orbit operations and program support.

Schedule: Not Applicable

Technical: Not Applicable

FY 1997

0

0

FY 1998

0

FY 1999

0

Total Cost

37,398

3,700

3,700

0

41,098

Project 0002

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

0002

(U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
<b>Related RDT&amp;E:</b>									
(U) PE 603441F - SBIRS Dem/Val	252,492	202,433	160,262	154,133	115,398	0	0	0	1,432,558
(U) PE 305911F - DSP	24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
(U) PE 604442F - SBIRS Low EMD	0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056

(U) D. Schedule Profile

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) On-orbit Operations	1	2	3	1	2	1	2	3	4
	X	X	X						

Project 0002

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604441F Space Based IR Arch (EMD) (Space)

0002

(U) A. Project Cost Breakdown (\$000 in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) On-orbit Ops and Support	3,700		
(U) Total Program	3,700	0	0

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or

Government  
Performing  
ActivityMethod/Type  
or Funding  
VehicleAward or  
Obligation  
DatePerforming  
Activity  
EACProject  
Office  
EACTotal  
Prior to  
FY 1997Budget  
FY 1997Budget  
FY 1998Budget  
FY 1999Budget to  
CompleteTotal  
ProgramProduct Development Organizations

Spectrum Astro CPAF Sep 95

Support and Management Organizations

Not Applicable

Test and Evaluation Organizations

Not Applicable

Government Furnished Property:

Not Applicable

Subtotal Product Development

Subtotal Support and Management

Subtotal Test and Evaluation

Adjustment

Total Project

44,815	3,700	0	0	0	48,515
0	0	0	0	0	0
0	0	0	0	0	0
-7,417	0	0	0	0	-7,417
37,398	3,700	0	0	0	41,098

Project 0002

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PE NUMBER: 0604442F

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PE TITLE: Space Based IR Arch (EMD) (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604442F Space Based IR Arch (EMD) (Space)								4598	
	COST (\$ in Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
4598 SBIRS Low Element EMD		0	0	33,328	79,064	148,749	420,206	823,950	5,938,759	7,444,056	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

Notes: Funding from PE 64441F, BPAC 4598 was transferred to this to establish a SBIRS Low EMD program element.

(U) **A. Mission Description and Budget Item Justification**  
 (U) The Space-Based Infrared System's (SBIRS) primary mission is to provide initial warning of a ballistic missile attack on the US, its deployed forces or its allies. SBIRS will incorporate new technologies to enhance detection; improve reporting of ICBM, SLBM and tactical ballistic missiles; and provide critical mid-course tracking and discrimination data for national and theater missile defense. This system will provide increased performance in order to meet requirements in US Space Command's Capstone Requirement Document and Operations Requirements Document. SBIRS will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated centralized ground station serving all SBIRS space elements and Defense Support System (DSP) satellites. This Program Element funds Program Definition and Engineering, Manufacturing & Development (EMD) activities for the LEO portion of the SBIRS program and is assigned to Budget Activity 5, Engineering and Manufacturing Development.

(U) **Acquisition Strategy:**  
 (U) The SBIRS program is managed through a single consolidated System Program Office (SPO) at the Space and Missile Systems Center, Los Angeles Air Force Base, CA. The SBIRS acquisition plan was approved in August 92 and is currently being updated to reflect the FY04 SBIRS Low accelerated launch date. The SBIRS Low EMD contract is scheduled for award 2QFY01 with the first SBIRS Low satellite launch planned in 4QFY04.

(U) FY 1997 (\$ in Thousands):  
 - (U) \$0 Total

(U) FY 1998 (\$ in Thousands):  
 - (U) \$0 Total

(U) FY 1999 (\$ in Thousands):  
 - (U) \$30,387 SBIRS Low Program Definition activities for Cost as an Independent Variable (CAIV), operational design and risk assessment, operations concept analyses, production planning, life cycle cost projections, and EMD planning  
 - (U) \$2,941 Radiation Hardened Parts  
 - (U) \$33,328 Total

Project 4598

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Exhibit R-2 (PE 0604442F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

5 - Engineering and Manufacturing Development

0604442F Space Based IR Arch (EMD) (Space)

PROJECT  
4598

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget /FY 1998 PB	0	0	0	0
(U) Appropriated Value				
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions				
b. SBIR				
c. Omnibus or Other Above Threshold Reprogram				
d. Below Threshold Reprogram				
(U) Adjustments to Budget Years Since FY 1998 PB			+33,328	7,444,056
(U) Current Budget Submit/FY 1999 President's Budget	0	0	33,328	7,444,056

## (U) Change Summary Explanation:

Funding: Funding was transferred from PE604441F, BPAC 654598.

\$2,941K FY99 increase funds for radiation hardened parts. \$672K FY99 reduction for non-pay inflation.

Schedule: Not Applicable

Technical: Not Applicable

## (U) C. Other Program Funding Summary (\$ in Thousands)

Not Applicable

## Related RDT&amp;E:

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Complete	Total Cost
(U) PE 0603441F - SBIRS Dem/Val	252,492	202,433	160,262	154,133	115,398	0	0	0	1,432,558
(U) PE 0305911F - DSP	24,668	20,689	12,037	7,595	7,587	4,462	4,760	0	1,941,972
(U) PE 0604441F - SBIRS High EMD	193,018	316,467	538,438	564,239	395,905	269,798	143,059	102,566	2,801,661

## (U) D. Schedule Profile

	FY 1997			FY 1998			FY 1999		
	1	2	3	4	1	2	3	4	
(U) Program Definition Contract Award									
(U) EMD Contract Award (1QFY01)									
(U) EMD Preliminary Design Review (2Q01)									
(U) SBIRS Low First Launch (4QFY04)								X	

Project 4598

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604442F Space Based IR Arch (EMD) (Space)

4598

(U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Program Definition	0	0	\$30,387
(U) Radiation Hardened Parts	0	0	\$2,941
(U) Total	0	0	\$33,328

(U) B. Budget Acquisition History and Planning Information (\$ in Thousands)Performing Organizations:

Contractor or

Government

Performing

Activity

Method/Type

or Funding

Vehicle

Award or

Obligation

Date

Performing

Activity

EAC

Project

Office

EAC

Total

Prior to

FY 1997

Budget

FY 1997

Budget

FY 1998

Budget

FY 1999

Budget to

Complete

Total

Program

Product Development Organizations

TBD Competitive/ 2QFY99

Cost Plus

Various TBD

Support and Management Organizations

Program Support Various

N/A

N/A

0

0

0

0

261,000

14,941

7,137,728

30,387

7,168,115

Test and Evaluation Organizations:

Not Applicable

Government Furnished Property:

Not Applicable

Subtotal Product Development

Subtotal Support and Management

Subtotal Test and Evaluation

Total Project

0

0

0

0

0

0

0

0

0

0

0

0

0

0

7,149,728

33,328

7,183,056

261,000

0

0

7,444,056

Project 4598

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PE NUMBER: 0604479F

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PE TITLE: Milstar LDR/MDR Sat Comm (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604479F Milstar LDR/MDR Sat Comm (Space)								5010	
	COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost	
5010 Milstar Sat Comm Sys		659,656	628,027	550,940	340,189	181,854	80,643	49,096	282,712	9,689,312	
Quantity of RDT&E Articles		0	0	0	0	0	0	0	0	0	

**(U) A. Mission Description and Budget Item Justification**

Milstar is a joint service program to develop and acquire extremely high frequency (EHF) satellites; a satellite mission control segment; and new or modified Army, Navy, and Air Force communication terminals for survivable, jam-resistant, worldwide, secure communications to strategic and tactical warfighters. Milstar I Satellites 1 and 2 have a low data rate (LDR) payload that supports strategic and tactical forces with emphasis on highly survivable, minimum essential communications. Milstar II Satellites 3M-6 have both LDR and medium data rate (MDR) payloads with increased tactical capabilities, including higher data rates to mobile forces and "nulling" that will neutralize close-in enemy jammers. (Satellite 3M was originally a Milstar I satellite, but it is being retrofitted with a MDR payload to function as a Milstar II satellite.) Milstar Terminals are funded under Program Element 0303601F. This program is in Budget Activity 5, Engineering and Manufacturing Development since it funds development of Milstar II.

**Acquisition Strategy:** Milstar is a sole source contract to Lockheed Martin for LDR/MDR protected communication satellites. Milstar has acquired 6 satellites. The first two satellites were acquired on a competitive basis and were launched in FY94 and FY95. The last 4 satellites will be launched in FY99, 00, 01, and 02.

Project 5010

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Exhibit R-2 (PE 0604479F)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604479F Milstar LDR/MDR Sat Comm (Space)	5010	
(U) FY 1997			
- (U) \$14,074	Milstar I		
- (U)	Continued Satellites 1 and 2 on-orbit operations support.		
- (U)	Completed Milstar I Phase II IOT&E.		
- (U)	Implemented Engineering Change Proposals (ECP) as needed based on operational requirements.		
- (U)	Continued MCS modifications to enhance mission control operations.		
- (U)	Transitioned to MCS organic support for software sustainment, mission planning, and satellite operations.		
- (U)	Develop and field operator training equipment.		
- (U) \$543,621	Milstar II		
- (U)	Completed Satellite 4 MDR payload manufacturing and started MDR integration and test.		
- (U)	Completed Satellite 4 bus component manufacturing.		
- (U)	Continued Satellite 4 LDR integration and test.		
- (U)	Continued Satellites 5 and 6 LDR unit build, MDR payload manufacturing, and bus component manufacturing.		
- (U)	Completed Satellite 3M MDR payload integration and test.		
- (U)	Started Satellite 3M integration and test.		
- (U)	Continued Milstar II MCS software upgrade for mission planning.		
- (U) \$70,811	Milstar I/II System Engineering		
- (U)	Continued LDR and MDR technical support.		
- (U)	Continued Milstar component integration support.		
- (U)	Continued Milstar software support.		
- (U) \$31,150	Basic Program Office support		
- (U) \$659,656	Total		

Project 5010

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Exhibit R-2 (PE 0604479F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604479F Milstar LDR/MDR Sat Comm (Space)

5010

(U) FY 1998

- (U)	\$495,388	Milstar I/II
- (U)		Complete Satellite 3M integration and test.
- (U)		Complete Satellite 4 LDR and MDR payload integration and test, and start satellite integration and test.
- (U)		Complete Satellite 5 LDR and MDR payload and bus component manufacturing.
- (U)		Start Satellite 5 LDR and MDR payload integration and test.
- (U)		Continue Satellite 6 LDR and MDR payload and bus manufacturing.
- (U)		Implement ECPs as needed based on operational requirements.
- (U)		Continue Milstar II MCS software upgrade for mission planning.
- (U)		Develop and field operator training equipment.
- (U)	\$76,706	Milstar I/II System Engineering
- (U)		Satellite 3 technical launch support.
- (U)		Continue LDR and MDR technical support.
- (U)		Continue Milstar component integration support.
- (U)		Continue Milstar software support.
- (U)	\$26,815	Mission Support
- (U)		Continue Satellites 1 and 2 on-orbit operations support.
- (U)	\$29,118	Basic Program Office support.
- (U)	\$628,027	Total

Project 5010

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Exhibit R-2 (PE 0604479F)

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## UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT		
5 - Engineering and Manufacturing Development	0604479F Milstar LDR/MDR Sat Comm (Space)	5010		
(U) FY 1999				
- (U) \$463,479	Milstar II			
- (U)	Satellite 3M launch, perform on-orbit checkout, and begin on-orbit testing.			
- (U)	Complete Satellite 4 integration, test, and deliver.			
- (U)	Complete Satellite 5 LDR and MDR payload integration and test, and start satellite integration and test.			
- (U)	Continue Satellite 6 LDR and MDR payload and bus manufacturing.			
- (U)	Continue Milstar II MCS software upgrade for mission planning.			
- (U)	Implement ECPs as needed based on operational requirements.			
- (U) \$30,770	Milstar I/II System Engineering			
- (U)	Satellites 3 and 4 technical launch support.			
- (U)	Continue LDR and MDR technical support.			
- (U)	Continue Milstar component integration support.			
- (U)	Continue Milstar software support.			
- (U) \$29,852	Mission Support			
- (U)	Continue Satellites 1, 2, and 3 on-orbit operations support.			
- (U) \$26,839	Basic Program Office support.			
- (U) \$550,940	Total			

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Exhibit R-2 (PE 0604479F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604479F Milstar LDR/MDR Sat Comm (Space)

5010

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total
(U) Previous President's Budget (FY 1998 PB)	683,685	676,690	555,050	9,574,841
(U) Appropriated Value	720,278	676,690		
(U) Adjustments to Appropriated Value				
a. Congressional General Reductions	-16,413	-27,829		
b. SBIR	-20,180	-20,834		
c. Omnibus Reprogramming	-15,000			
d. Below Threshold Reprogramming (BTR)	-7,900			
e. Rescissions	-1,129			
(U) Adjustments to Budget Years Since FY 1998 PB			-4,110	
(U) Current Budget Submit/FY 1999 President's Budget	659,656*	628,027	550,940	9,689,312

\* Does not reflect three BTRs that total -\$1,911.

## (U) Change Summary Explanation:

Funding: FY97 BTR actions include -\$400k for Joint Program Office Deskbook (65808F), -\$1M for Modified Miniature Receive Terminals (33110F), -\$500k for DMSP (35160F), -\$3M for the Space Test Program (63402F), -\$3M for the SPACETRACK program (35910F). FY99 adjustment funded higher priority AF and DoD requirements.

Schedule: None.Technical: None.

## (U) C. Other Program Funding Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Comp	Total
(U) Milstar AF Command Post Terminals, BA 63,	4,653	2,612	4,816	8,429	2,403	433	428	Cont	TBD

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\* PE 33601F (Other Procurement) funds Milstar AF-developed ground and airborne Command Post Terminals. PE 33601F also funds various AF MILSATCOM terminals.

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Exhibit R-2 (PE 0604479F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE \_\_\_\_\_

February 1998

## BUDGET ACTIVITY

## 5 - Engineering and Manufacturing Development

PE NUMBER AND TITLE

**0604479F Milstar LDR/MDR Sat Comm (Space)**

## PROJECT

**5010**

**(U) Related RDT&E:**

(U) PE 0303601F, MILSATCOM Terminals

(U) PE 0603430F, Advanced MILSATCOM

(U) PE 0604577N, EHF Satellite Communications

(U) PE 0603432F, Polar Satellite Communications Program (Polar Adjunct)

**(U) D. Schedule Profile**

	FY 1997	FY 1998	FY 1999
1	2	4	4
	3	1	1
		2	2
		3	3
			4

(U) IOCI

(U) Complete LDR IOT&E, Phase II

(U) Milstar II (LDR/MDR)

(U) Satellite 3M Launch

(U) Satellite 4 Launch - 20FY00

(U) MDR IOT&E - 20FY00

(U) IOC II - 10FY01

(U) Satellite 5 Launch - 10FY01

(U) Satellite 6 Launch - 10FY02

(U) FOC - 10FY05

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)										DATE	PROJECT																																								
BUDGET ACTIVITY										PE NUMBER AND TITLE																																									
5 - Engineering and Manufacturing Development										0604479F Milstar LDR/MDR Sat Comm (Space)																																									
										5010																																									
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>																																																			
<table><tr><td></td><td>FY 1997</td><td>FY 1998</td><td>FY 1999</td></tr><tr><td>(U) Satellites 1/2/3L</td><td>14,074</td><td>0</td><td>0</td></tr><tr><td>(U) Satellite 3M</td><td>90,848</td><td>80,587</td><td>69,356</td></tr><tr><td>(U) Satellite 4</td><td>198,676</td><td>164,343</td><td>155,666</td></tr><tr><td>(U) Satellite 5</td><td>147,361</td><td>131,100</td><td>118,368</td></tr><tr><td>(U) Satellite 6</td><td>106,736</td><td>119,358</td><td>120,089</td></tr><tr><td>(U) Milstar I/II System Engineering</td><td>70,811</td><td>76,706</td><td>30,770</td></tr><tr><td>(U) Mission Support</td><td>0</td><td>26,815</td><td>29,852</td></tr><tr><td>(U) Basic Program Office support</td><td>31,150</td><td>29,118</td><td>26,839</td></tr><tr><td>(U) Total</td><td>659,656</td><td>628,027</td><td>550,940</td></tr></table>													FY 1997	FY 1998	FY 1999	(U) Satellites 1/2/3L	14,074	0	0	(U) Satellite 3M	90,848	80,587	69,356	(U) Satellite 4	198,676	164,343	155,666	(U) Satellite 5	147,361	131,100	118,368	(U) Satellite 6	106,736	119,358	120,089	(U) Milstar I/II System Engineering	70,811	76,706	30,770	(U) Mission Support	0	26,815	29,852	(U) Basic Program Office support	31,150	29,118	26,839	(U) Total	659,656	628,027	550,940
	FY 1997	FY 1998	FY 1999																																																
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(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>																																																			
<b>Performing Organizations:</b>																																																			
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program																																									
<b>Product Development Organizations</b>																																																			
LMSC (Milstar I) [Sats 1,2,3L]	C/CPAF	Jun 83	2,181,587*	2,181,587*	4,727,752	14,074	0	0	0	4,741,826																																									
LMSC (Milstar II) [Sats 3M, 4, 5, 6]	SS/CPAF	Oct 92/ Nov 94	3,355,600	3,355,600	1,668,224	543,621	495,388	463,479	408,749	3,579,461																																									
LMSC (Mission Support)	CPAF	Sep 97	56,667	56,667	0	0	26,815	29,852	0	56,667																																									
Mission Support	TBD	TBD	TBD	TBD	0	0	0	0	300,000	300,000																																									
LINCOM	SS/CPAF	Various			18,692	3,743	3,369	1,000	3,000	29,804																																									
Lincoln Lab	SS/MIPR	Various			20,489	4,203	4,000	3,800	3,800	36,292																																									
Miscellaneous	Various	Various			262,545	62,865	69,337	25,970	95,185	515,902																																									

Project 5010

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Exhibit R-3 (PE 0604479F)

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**RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)**

**Exhibit R-3 (PE 0604479F)**

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)		DATE	February 1998
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT	
5 - Engineering and Manufacturing Development	0604479F Milstar LDR/MDR Sat Comm (Space)	5010	
Government Furnished Property:			
<u>Product Development Property</u>			
None.			
<u>Support and Management Property</u>			
None.			
<u>Test and Evaluation Property</u>			
None.			
Subtotal Product Development	6,697,702	524,101	810,734
Subtotal Support and Management	218,492	26,839	123,761
Subtotal Test and Evaluation	0	0	0
Total Project	6,916,194	550,940	934,495
Note: Due to the overrun on the Milstar I contract, an Over Target Baseline (OTB) was established in Jan 91 to provide a credible cost performance baseline for the remaining contractual effort. The EAC reflects the unclassified cost of remaining work scheduled after the Jan 91 rebaseline. The total program value includes all unclassified prior funding (approx \$4 Billion in FY82 - 92), all unclassified fees & incentives, and ECPs not yet definitized.			

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Exhibit R-3 (PE 0604479F)

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PE NUMBER: 0604480F

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PE TITLE: Global Positioning System Block IIF (Space)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE							
BUDGET ACTIVITY		PROJECT							
5 - Engineering and Manufacturing Development		0005							
PE NUMBER AND TITLE		0604480F Global Positioning System Block IIF (Space)							
COST (\$ In Thousands)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
0005 NAVSTAR GPS BLOCK IIF	36,426	66,918	62,591	26,677	23,099	16,892	14,244	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

**(U) A. Mission Description and Budget Item Justification**

Activities include satellite design and development; control system, training simulator, and Mission Operation Support Center development and test; satellite upgrade design and development; control system, simulator and support center software upgrades; and R&D efforts to support NAVSTAR Global Positioning System (GPS) Block IIF deployment. This PE is in Budget Activity 5 - Engineering and Manufacturing Development (EMD), and supports research and development of GPS Space and Control systems within the Block IIF Sustainment Program.

Acquisition Strategy: Single satellite development/production contract was competitively awarded in April 1996.

**(U) FY 1997 (\$ in Thousands):**

- (U)	\$31,652	Continued Block IIF - System Sustainment Satellite System Development
- (U)	\$2,699	Continued Block IIF - System Sustainment Ground System Development
- (U)	\$498	Studies
- (U)	\$305	Mission Support
- (U)	\$172	Launch Support
- (U)	\$1,100	GPS Modernization
- (U)	\$36,426	Total

**(U) FY 1998 (\$ in Thousands):**

- (U)	\$54,737	Continue Block IIF - System Sustainment Satellite System Development
- (U)	\$12,081	Continue Block IIF - System Sustainment Ground System/Simulator Development
- (U)	\$100	Launch Support
- (U)	\$66,918	Total

Project 0005

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Exhibit R-2 (PE 0604480F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

## 5 - Engineering and Manufacturing Development

0604480F Global Positioning System Block IIF  
(Space)

0005

## (U) FY 1999 (\$ in Thousands):

-	(U)	\$34,461	Continue Block IIF - System Sustainment Satellite System Development
-	(U)	\$27,540	Continue Block IIF - System Sustainment Ground System/Simulator Development
-	(U)	\$590	Launch Support
-	(U)	\$62,591	Total

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost Continuing
(U) Previous President's Budget (FY1998 PB)	35,406	71,094	67,853	
(U) Appropriated Value	37,142	71,094		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-778	-2,354		
b. SBIR	-958	-1,822		
c. Omnibus or Other Above Threshold Reprogram	1,100			
d. Below Threshold Reprogramming	-80			
e. Rescission				
(U) Adjustments to Budget Years Since FY1998 PB			-5,262	
(U) Current Budget Submit/FY1999 President's Budget	36,426	66,918	62,591	Continuing

## (U) Change Summary Explanation:

Funding: FY97 Below Threshold Reprogramming funds GPS Modernization (\$1,100); rescission for Bosnia contingency (-\$80).  
 FY99 adjustments due to non-pay inflation (-\$1,262); Realignment to PE 0305165F, Missile Procurement, to properly fund program activities (-4,000).  
 Schedule: No Change  
 Technical: No Change

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Exhibit R-2 (PE 0604480F)

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604480F Global Positioning System Block IIF  
(Space)

0005

(U) C. Other Program Funding Summary (\$ in Thousands)

	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>To Compl</u>	<u>Total Cost</u>
(U) PE 0305165F, NAVSTAR GPS (Space and Control fund for Block IIA/IIR/IIF, IPO Support, and Control Segment									
(U) Operations and Maintenance, (PE 0305165F, BA 1 - Operating Forces)	19,972	20,714	25,540	22,650	26,364	26,606	27,452	Cont	Cont
(U) Missile Procurement, (PE 0305165F, BA 5 - Space and Other Support, P-20, 21)	196,965	157,630	174,795	226,822	192,897	134,803	136,487	Cont	Cont
(U) Other Procurement, (PE 0305165F, BP 83 - Electronics and Telecommunications Equipment, WSC 6790, P-68)	10,663	10,060	8,430	1,464	665	795	861	Cont	Cont

Related RDT&E:

(U) PE 0305164F, NAVSTAR GPS User Equipment

(U) PE 0101221N, Fleet Ballistic Missile System

(U) PE 0301357F and 0305913FNuclear Detonation Detection System (NDS)

(U) PE 0305119F Space Boosters (Delta II)

(U) PE 0305130F, Consolidated Space Operations Center (CSOC)

(U) PE 0305165F, NAVSTAR GPS Space/Control

(U) D. Schedule Profile

	<u>FY 1997</u>		<u>FY 1998</u>		<u>FY 1999</u>
1	2	3	4	1	2
	x			4	3
(U) Satellite Preliminary Design complete					
(U) Satellite Final Design complete					
(U) Advanced Integration complete					

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Exhibit R-2 (PE 0604480F)

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# RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604480F Global Positioning System Block IIF

0005

(Space)

## (U) A. Project Cost Breakdown (\$ in Thousands)

	FY 1997	FY 1998	FY 1999
(U) Satellite Preliminary Design Complete	12,173	0	0
(U) Satellite Final Design Complete	8,182	25,547	0
(U) Satellite Development Complete	11,297	29,190	34,461
(U) Ground/Control System Development	2,699	12,081	27,540
(U) Advanced Integration/Other Studies	498	0	0
(U) Mission Support	305	0	0
(U) GPS Modernization	1,100	0	0
(U) Launch Support	172	100	590
(U) <b>Total</b>	36,426	66,918	62,591

## (U) B. Budget Acquisition History and Planning Information (\$ in Thousands)

### Performing Organizations:

Contractor or Government Performing Activity	Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
<u>Product Development Organizations</u>										
Block IIF	FPAF/CPAF	Apr 96	Cont	Cont	17,680	34,599	66,818	62,001	Cont	Cont
Development, Boeing North America, Seal Beach, CA										
<u>Support and Management Organizations</u>										
Multiple	Various	Various	N/A	N/A	850	1,827	100	590	Cont	Cont
<u>Test and Evaluation Organizations</u>										
N/A										

Project 0005

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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 EXHIBIT)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604480F Global Positioning System Block IIF

0005

(Space)

Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	Budget FY 1998	Budget FY 1999	Budget to Complete	Total Program
Government Furnished Property:										
N/A										
Subtotal Product Development										
Subtotal Support and Management										
Subtotal Test and Evaluation										
Total Project										
					18,530	36,426	66,918	62,591	Cont	Cont
					17,680	34,599	66,818	62,001	Cont	Cont
					850	1,827	100	590	Cont	Cont
					0	0	0	0	0	0

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PE NUMBER: 0604600F

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PE TITLE: Munitions Dispenser Development

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY			PE NUMBER AND TITLE							PROJECT	
5 - Engineering and Manufacturing Development			0604600F Munitions Dispenser Development							1015	
COST (\$ In Thousands)			FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
1015	Wind Corrected Munitions Dispenser (WCMD) Kit		46,142	17,519	7,559	0	0	0	0	0	144,720
	Quantity of RDT&E Articles		184/\$9174	6/\$268	0	0	0	0	0	0	204/\$11584
<b>(U) A. Mission Description and Budget Item Justification</b> This project develops an inertially guided tail kit for CBU-87B, CBU-89B, and CBU-97B dispensers to provide corrections for the effects of wind transients and ballistic errors caused by wind when these munitions are released from medium to high altitudes. Wind Corrected Munitions Dispenser (WCMD) kit fitted weapons will improve effectiveness of both bombers and fighters and significantly contribute to Air Force war fighting capabilities. WCMD kit fitted CBU-97's dropped from bombers are key to stopping enemy armored forces. This is funded in BA 5, Engineering and Manufacturing Development because it develops a weapon system.											
<b>(U) Acquisition Strategy:</b> A full and open competition in FY 1995 led to dual awards for a competitive development effort that included a competitive fly-off. The downselect to one contractor occurred in Jan 1997. The Cost-Plus Award Fee (CPAF) Pilot Production contract awarded to Lockheed-Martin includes production options for five years of production on a Firm-Fixed Price (FFP) basis.											
<b>(U) FY 1997 (\$ in Thousands):</b>											
-	(U) 25,184	Completed competitive EMD contract. Start contract for pilot production of Wind Corrected Munitions Dispenser (WCMD) tail kits. Start Non-1760 development study									
-	(U) 5,465	Completed fly-off with two contractors. Conduct combined F-16 and B-52 DT&E/IOT&E									
-	(U) 2,899	Program management support; includes travel, program office supplies and equipment, training, and technical engineering support									
-	(U) 22	Provided other government support, GFE (B-52 & F-16 Data Transfer Cartridge)									
-	(U) 11,828	Continued aircraft integration on F-16, B-52, and F-15E									
-	(U) 744	Continued development of Common Munition BIT (Built-in-Test) Reprogramming Equipment (CMBRE)									
-	(U) \$46,142	Total									
<b>(U) FY 1998 (\$ in Thousands):</b>											
-	(U) 11,279	Continue pilot production contract. Complete Non-1760 development study									
-	(U) 2,134	Continue combined DT&E/IOT&E flight tests.									
-	(U) 2,356	Program management support; includes travel, program office supplies and equipment, training, and technical engineering support									
-	(U) 1,750	Complete integration on B-52 and continue integration on F-16									
-	(U) \$17,519	Total									
Project 1015											
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## RDT&amp;E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 1998

BUDGET ACTIVITY

PE NUMBER AND TITLE

PROJECT

5 - Engineering and Manufacturing Development

0604600F Munitions Dispenser Development

1015

## (U) FY 1999 (\$ in Thousands):

- (U) 1,200 Complete DT/OT testing  
 - (U) 1,559 Program management support; includes travel, program office supplies and equipment, training, and technical engineering support  
 - (U) 4,800 Complete integration on F-16  
 - (U) \$7,559 Total

## (U) B. Program Change Summary (\$ in Thousands)

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	53,631	18,076	7,711	155,741
(U) Appropriated Value	56,229	19,676		
(U) Adjustments to Appropriated Value				
a. Cong Gen Reductions	-1,193	-779		
b. SBIR	-1,405	-1,378		
c. Omnibus or Other Above Threshold Reprogram	-3,900			
d. Below Threshold Reprogramming	-3,589			
e. Rescissions			-152	
(U) Adjustments to Budget Years Since FY 1998 PB				
(U) Current Budget Submit/FY 1999 President's Budget	46,142	17,519	7,559	144,720

## (U) Change Summary Explanation:

Funding: Congressional rescission in FY 97 for Bosnia of \$3,589, and \$3,900 reprogrammed to meet higher Air Force priorities. The funds were available due to 3 month stop-work order resulting from a contractor protest. Congress added \$1,600 in FY 98 to cover the FY 97 effort slipped into FY 98 as a result of the protest. In FY 98, \$417 is pending reprogramming to fund higher priorities and additional \$8 for SBIR. FY 99 reduction of \$152 due to inflation adjustment.

Schedule: A stop work order for 3 months (Feb 97-Apr 97) due to a contractor protest delayed the start of DT&E/IOT&E from May 97 to Sep 97. Consequently, the LRIP decision/award slips from 2 Qtr FY 98 to 3 Qtr FY 98. However, by LRIP II (Jan 99) the program recovers.

Technical: No changes

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	February 1998
BUDGET ACTIVITY		PE NUMBER AND TITLE								PROJECT	
5 - Engineering and Manufacturing Development		0604600F Munitions Dispenser Development								1015	
(U) C. Other Program Funding Summary (\$ in Thousands)											
(U)	WCMD Kit Production, Proc of Ammo, AF, (Appn 3011); PE 0207600F	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	To Compl	Total Cost	
		0	7,962	13,862	49,807	101,323	108,904	80,779	145,724	508,361	
(U)	SEEK EAGLE (WCMD), Proc of Ammo, AF (Appn 3011); PE 0207590F	0	4,012	0	0	1,824	0	0	0	5,836	
(U)	TOTAL	0	11,974	13,862	49,807	103,147	108,904	80,779	145,724	514,197	
(U) D. Schedule Profile											
(U)	Engineering Milestones	FY 1997			FY 1998			FY 1999			
	Design Reviews (3Q 96)	1	2	3	4	1	2	3	4		
	Pilot Production										
(U)	T&E Milestones										
	Aircraft Cert Tests (FY 95)										
	Contractor Dev Testing (1Q 96)										
	Competitive Fly-Off										
(U)	Contract Milestones										
	EMD Contract Award (FY 95)										
	Downselect										
(U)	Other Program Events										
	DT/OT										
	LRIP Decision										
	LRIP Award 1/Award 2										
	Milestone III										
	FRP 1 Award (FY 00/Q2)										

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RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)			DATE	PROJECT
BUDGET ACTIVITY	PE NUMBER AND TITLE			
5 - Engineering and Manufacturing Development	0604600F Munitions Dispenser Development			1015
(U) A. <u>Project Cost Breakdown (\$ in Thousands)</u>				
		<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
(U) Major Contracts		25,184	11,279	0
(U) Support Contracts		1,865	1,582	480
(U) Program Office Support		1,034	774	1,079
(U) Test And Evaluation		5,465	2,134	1,200
(U) Aircraft Integration		11,828	1,750	4,800
(U) Government Furnished Equipment (GFE)		22	0	0
(U) CMBRE		744	0	0
(U) Total		46,142	17,519	7,559
(U) B. <u>Budget Acquisition History and Planning Information (\$ in Thousands)</u>				
Performing Organizations:				
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC
			Total Prior to FY 1997	Budget FY 1997
			FY 1998	FY 1999
			Budget to Complete	Total Program
<u>Product Development Organizations</u>				
WCMD	CPAF	Jan 98	77,023	40,560
Development Contractors	Lockheed Martin		25,184	11,279
			0	0
			0	77,023
<u>Support and Management Organizations</u>				
ASC/YH	N/A	varius	N/A	3,164
Sverdrup	CPAF	Oct 97	N/A	2,042
Miscellaneous	CPAF	varius	N/A	1,536
			1,034	774
			906	972
			959	610
			1,079	0
			0	0
			480	0
			0	6,051
			0	3,920
			0	3,585

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## RDT&amp;E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)

BUDGET ACTIVITY				PE NUMBER AND TITLE			DATE	PROJECT		
RDT&E PROGRAM ELEMENT/PROJECT COST BREAKDOWN (R-3)				0604600F Munitions Dispenser Development			February 1998	1015		
5 - Engineering and Manufacturing Development										
Contractor or Government Performing Activity	Contract Method/Type or Funding Vehicle	Award or Obligation Date	Performing Activity EAC	Project Office EAC	Total Prior to FY 1997	Budget FY 1997	FY 1998	FY 1999	Budget to Complete	Total Program
Test and Evaluation Organizations										
46 OG/OGML	REO	Oct 98	N/A	N/A	1,927	5,465	2,134	1,200	0	10,726
Acft Integration	AF 616	Oct 98	N/A	N/A	16,165	11,828	1,750	4,800	0	34,543
Government Furnished Property:										
Product Development Property										
SFW/CEM/SE	FPIF	Apr 96	N/A	N/A	4,479	22	0	0	0	4,501
CMBRE	CPAF	Jul 97	N/A	N/A	3,627	744	0	0	0	4,371
Support and Management Property: None										
Test and Evaluation Property: None										
Subtotal Product Development										
Subtotal Support and Management										
Subtotal Test and Evaluation										
TOTAL										

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